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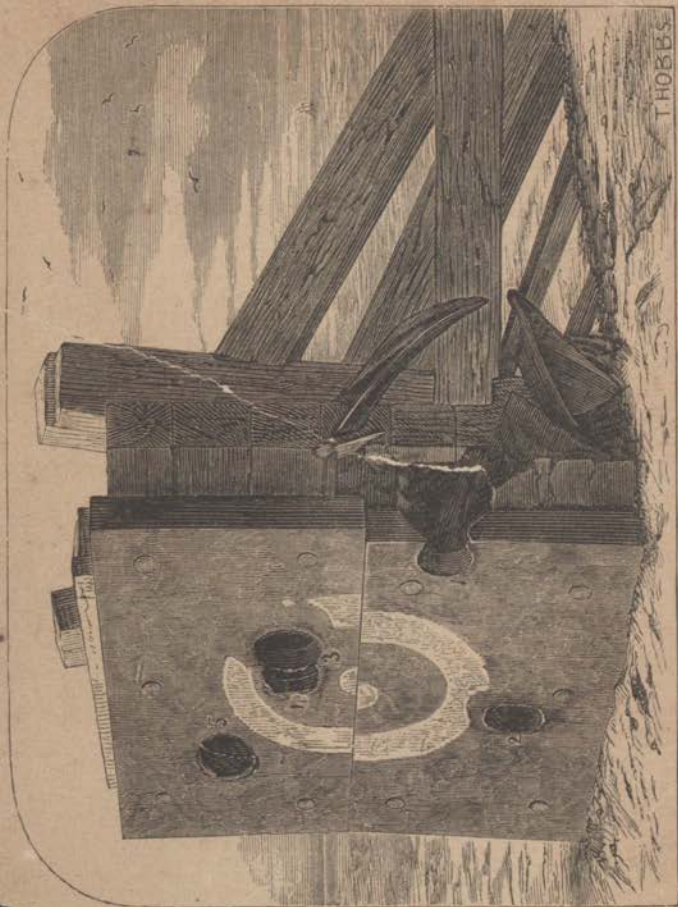
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FRONTISPIECE.



THE AGINCOURT TARGET.—EFFECTS OF THE MACKAY GUN AT 200 YARDS.

The Target comprises the frame and skin of the iron ship, faced with 9-inch teak and 2½-inch armour plates.

passed
and.

passed
beyond.

No. 3 Shot passed
185 yards beyond.

No. 4 Shot passed
1472 yards beyond.

No. 5 Shot passed
384 yards beyond.

The charge in all
cases was 30 lbs.

SHOEBURYNESSE

AND

THE GUNS:

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A PHILOSOPHICAL DISCOURSE.

BY

P. BARRY,

AUTHOR OF "DOCKYARD ECONOMY AND NAVAL POWER;" "THE DOCKYARDS,
SHIPYARDS, AND MARINE OF FRANCE," ETC.

"The Cannons, faithful to their system, remained in a wise and masterly inactivity."—Sir J.
Mackintosh, *Vindice Gallica*.

"When you wish to walk, do you stand motionless until you have a confused notion of all the
sciences connected with the laws of locomotion."—*Tit for Tat*.

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LONDON:

SAMPSON LOW, SON, AND MARSTON, 14, LUDGATE HILL.

1865.

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PRINTED BY WILLIAM ODHAMS, BURLEIGH-STREET,
STRAND, W.C.

Dedication.

TO

EARL DE GREY AND RIPON, SECRETARY OF STATE
FOR WAR,

I BEG TO DEDICATE THESE PAGES,
BECAUSE MY RELATIONS WITH THE WAR-OFFICE HAVE BEEN ALWAYS CORDIAL,
BECAUSE I BELIEVE
HIS LORDSHIP IS ANXIOUS TO DISCHARGE HIS DUTY,
AND BECAUSE I BELIEVE
HE STANDS IN NEED OF THE STRAIGHTFORWARD TESTIMONY WHICH I, AS A MEMBER
OF THE FOURTH ESTATE, HAVE GIVEN.

PREFACE.

I have advisedly appended the term philosophical discourse to the title to set myself right with the public. The books which I have written on dockyards and this book on guns are not off-hand criticisms, but serious, although humble efforts, to rescue the great public questions with which I deal from the lofty pretension, the unmeaning words, and the mystification of those who desire to appear learned, and who find it advantageous, professionally advantageous, to practise imposition. A philosophical discourse is a true discourse, representing fact as it is, and not as it appears to be, nor as it may be conceived to be. It takes truth as it finds it, and presents to the understanding the material for a sound, a common sense, and an exhaustive judgment. The man who reads this book will know as much of guns—that is, the use of them—as Sir William Armstrong, Mr. Whitworth, the Director-General of Ordnance, or Lord De Grey.

It is an ungracious task discussing the subject-matter of this book as I have done. I will have made to myself no end of enemies, and very likely not a single friend. But it is something, indeed it is a great reward,

to feel that the discharge of a public duty, without fear or favour, and in a truly conscientious spirit, is calculated to change a corrupt and effete system of administration and control, and by so doing raise the freest, happiest, most frugal, and laborious nation to that pinnacle of power from which in the course of the past few years it has strangely fallen. England in the hands of wise administrators might easily become, with fewer burdens than those at present borne, the mistress of the world; while England as it is, is only powerful in comparison with itself at previous periods—when there were no ironclads and no patriot army of Volunteers. Against England at this hour the United States could array an overwhelming force on land; marshal an army almost to our regiment; and on the sea bring six efficient ironclads against our one, firing 100lb. of powder against our 16lb. Against England at this hour France could bring to bear a system of administration and control of which the Emperor has a right to boast. It is a system for the combat whenever the battle-note is sounded; ours a system to be buried whenever the sword leaves the scabbard, and to be remembered to the shame of living Englishmen in monumental brass within the precincts of Westminster Abbey.

Who are the administrators of the power of free and happy England? I answer, without fear of contradiction, and from the information of a well-stored mind, the administrators of the power of free and happy England are the unfittest, and, in the main, the unworthiest, men in England. A friend of mine, for

whom I entertain high esteem, remarked to me the other day that there are three classes of persons never privileged to cross his threshold—parsons for their inconsistency, doctors for their ignorance, and officers for their immorality. Without endorsing his exclusions, the time, I think, has come when the honour of the army might beneficially be enlarged to include public abstinence from the grosser vices which degrade mankind. To that question I have felt called on to direct the attention of his Royal Highness the Duke of Cambridge and Lord De Grey. So much for unworthiness. What next, of the fitness of the administrators of the power of free and happy England? The administrators are chiefly officers; and the duty of administrators, whether of the army or of the navy, in the field, on the sea, in the garrison, or in the harbour, is the commonest kind of business routine. The man of business is, therefore, the *beau idéal* of an administrator. And if this is so, who will affirm that officers have had any training for the duties of administrators? They are obviously the wrong men to employ; and it is to their employment that I attribute the whole of our administrative inefficiency, misrule, and waste. The employment of officers as administrators is, I think, one of the most shortsighted economic fallacies of the time—giving an idle class of men important State work to do, because they happen to be idle, and shutting our eyes to their extravagance, and to the misery and dishonour they may some day soon occasion us. On this point I may, without presumption, claim to speak

with some authority. The other day I was employed by the representative of the United States, Chief Engineer J. W. King, to furnish, with other matter, all the information and advice I could give for the construction and organisation of the new arsenal below Philadelphia.*

* I sent the following letter to the *Times* on the occasion of the allusion, in a leading article, to Mr. J. W. King's report:—

“CHIEF ENGINEER KING'S REPORT.

To the Editor of the Times.

“SIR,—In case that too much or too little importance should be attached by you or the public to the report of Chief Engineer King of the United States navy, it will be well for me to say that his report is, in substance, my report.

“On Mr. King's arrival in this country he placed himself in communication with me, and, in addition to receiving all the information that I could give him about France and this country, all his notes were placed in my hands for consideration and revision. Further, such investigations as he could not pursue I prosecuted for him; and my investigations for him continued after his departure for the New York Navy Yard.

“I mention these things that I may be heard in explanation of one or two matters of fact.

“*First*—America is a wood, not an iron, country; its iron production is as yet limited; and that limited production has been subjected to the extraordinary demands of war. That is why the American contractors have failed in the turning out of iron or iron armour ships within the contract time; the terms of the contracts not admitting of enlargement to correspond with the higher price of iron. But there has also been a great disturbance in the labour market, operating in the same direction, and so powerfully as to interfere with the satisfactory carrying out of even wood ship contracts.

“*Second*—The United States Government design the arsenal below Philadelphia chiefly to obtain security without having to resort to the construction of fortifications. Convenience and economy likewise suggest the possession of armour mills, foundries, and engine shops on the coast near the Pennsylvania coal and iron fields. These are the objects of the new arsenal; and I am warranted in adding that the popular form of the United States Government precludes the possibility of the Navy Department adopting our English dockyard manufacturing system.

“*Third*—I found that Mr. King was strongly biassed in favour of Government establishments; and it is within my knowledge that at Chatham his strong prepossessions were greatly strengthened.

“Trusting that my close connection with Mr. King's report will be a justification for this intrusion,

“I am, Sir, yours faithfully,

“P. BARRY,

“Author of *Dockyard Economy and Naval Power*.

1st February, 1865.

Last year the Council of the Royal United Service Institution requested me to lecture before the members on Dockyard Administration.* Then, I may add, that

The following correspondence was published in the *Morning Herald* and in the *Standard* of the 5th January, 1865; and a portion of it previously in the *Morning Post*—

“Whitehall-yard, August 9, 1864. -

“DEAR SIR,—I have been desired by the council to ask you, as the author of ‘Dockyard Economy and Naval Power,’ if you will kindly consent to favour the members of the Royal United Service Institution with a lecture next year on ‘Dockyard Administration.’ The lectures and papers after their delivery are published (at the discretion of the council) in the journal of the institution. I shall feel obliged by an answer at your earliest convenience.—I remain, yours faithfully,

“B. BURGESS (Captain), Secretary.

“P. Barry, Esq.”

“Nov. 8, 1864.

“Mr. P. Barry presents his compliments to the secretary of the United Service Institution, and begs to ask the following question:—

“Mr. Barry, in dealing with the subject of dockyard administration, will subject to criticism the workshops, machinery, tools, &c., of the Royal dockyards, and of some private establishments, and for the sake of clearness it will be necessary to make a few simple chalk tracings on a black board, or to prepare drawings.

“Will, therefore, the council of the United Service Institution be content with the chalk tracings of Mr. Barry as the lecture proceeds, or will the council sanction a moderate outlay for drawings?

“Mr. Barry avails himself of the opportunity afforded him in asking this question to state, for the information of the council, that since the request to deliver the lecture all the Royal dockyards have been specially visited; further inquiries have been prosecuted in the public and private establishments of France, and official information has been received from the United States.

“General principles of dockyard administration will accordingly be laid down with an approach to certainty, and also special principles applicable to England, France, and the United States.

“Care will be taken to render the lecture concise and interesting.”

“Whitehall, Nov. 8, 1864.

“DEAR SIR,—With reference to my letter of the 9th August, I am directed by the council of the Royal United Service Institution to inform you that, on reconsidering the proposed arrangement for the ensuing lecture season, they regret that they are now unable to avail themselves of the lecture which you so kindly consented to deliver.—I remain, yours faithfully,

“B. BURGESS (Captain), Secretary.”

“Royal United Service Institution, Whitehall-yard, Nov. 8, 1864.

“Lieut.-Colonel Alcock presents his compliments to Mr. Barry, and cannot allow the

in early life the time spent by other young men at college was devoted by me to business pursuits ; and that of late years the practical business knowledge thus acquired has made me an acceptable contributor to the

enclosed official note from the secretary to be forwarded without expressing, upon his own part, the hope that the change of arrangements which has become unavoidable with respect to the course of lectures for the ensuing season will not put Mr. Barry to any inconvenience."

"Nov. 9, 1864.

"Mr. P. Barry presents his compliments to Lieut.-Colonel Alcock and Captain Burgess, and regrets that his letter, crossing those from Whitehall-yard, was not sent before the alteration in the arrangements of the council took place, as otherwise the expense which he has incurred and the time which he has given to the subject might have been considered sufficient to outweigh all other considerations."

"Lieutenant-Colonel Alcock presents his compliments to Mr. Barry, and is sorry to find by his letter of the 9th that he has been put to trouble and expense in preparing for the proposed lecture on dockyard administration, and he will cause Mr. Barry's note to be brought under the notice of the council, but in doing so Colonel Alcock will not be able to ask them to reconsider the course which they have thought it necessary to adopt with reference to the lecture arrangements for the ensuing year.

"Royal United Service Institution, Whitehall-yard, Nov. 11, 1864."

"Whitehall-yard, Dec. 8, 1864.

"Captain Burgess presents his compliments to Mr. Barry, and, referring to the vice-chairman's letter of the 11th ultimo, has been desired by the council to forward him a copy of the resolution passed at the meeting on the 5th instant—viz., 'That Mr. Barry be requested to state precisely what claims he makes for expenses actually incurred in preparing his lecture for the Royal United Service Institution.'

"P. Barry, Esq."

"Dec. 9, 1864.

"Mr. P. Barry presents his compliments to Captain Burgess.

"Mr. Barry, flattered by the request of the council of the Royal United Service Institution to lecture, proceeded to obtain information that would be creditable to himself and the council of the institution.

"Accordingly, the workshops, factories, &c., of Keyham, Portsmouth, Chatham, Sheerness, Woolwich, and Deptford, were gone over with great care. Havre was also re-visited, and also Cherbourg Dockyard—the mechanical order and capabilities of both being accurately ascertained.

"These inquiries, extending over several weeks, cost out of pocket, £35. * Thirty-five pounds."

leading commercial publications of the day—to the *Bankers' Magazine*, the *Money Market Review*, and other journals. And what does my business experience amount to, expressed in the fewest words? It amounts to this—that business is the most exacting of all occupations, demanding constant watchfulness and effort, and that, to the oldest even, it is always teaching something new. Therefore, to imagine that captains, majors, colonels, and admirals are fit and proper persons for the administration and control of the army and the navy is the merest folly. When the army and navy of the country are administered as they ought to be, soldiers and sailors will do the fighting, if there is any to be done, and shrewd men of business from the City, or

“Whitehall-yard, Jan. 3, 1865.

“SIR,—I am desired by the council to acknowledge the receipt of your letter of the 9th December, 1864, suggesting a claim of £35 for expenses incurred by you in preparing your lecture for this institution. They very much regret that they have no fund at their disposal to enable them to meet this claim, and they have never paid the travelling expenses of any lecturer.

“If, however, any small expense had been incurred by you in the preparation of plans or drawings they would have endeavoured to have met your wishes. They observe, however, that your letter does not contain any such charge, and they are therefore obliged to decline to entertain your proposal.—I have the honour to be, Sir, your obedient servant,

“B. BURGESS (Captain), Secretary.

“P. Barry, Esq.”

“Jan. 4, 1865.

“SIR,—I beg to remind you that my letter of the 9th of December was written in obedience to your own request of the previous day, and that it neither suggests a claim of £35 nor submits a proposal.

“I have only to add, in the further reply to your letter of yesterday, that I shall take an early opportunity of placing the correspondence in the hands of my solicitor for the usual proceedings which succeed to breaches of faith of a pecuniary nature, whether the offenders are or are not so fortunate as to possess a fund for the liquidation of the responsibilities they happen to incur.—I have the honour to be, Sir, your obedient servant,

“P. BARRY.

“B. Burgess, Esq.”

from Manchester, Liverpool, or Glasgow will attend to those things which are neither military nor naval. That the army, the navy, and the civil service have frequently produced good administrators proves, if it proves anything, that they are the exceptions to the rule.

In case it may be supposed that I have been unwarrantably severe with any class of persons, I would say, in the way of justification, that the individual who accepts an appointment on a Shoeburyness committee, who brings forward an invention for adoption in the army or the navy, or who is in the habit of writing letters on such inventions to the newspapers, assumes a grave responsibility. He assumes no less a responsibility than that of seeking to change the armament of this great country to his views. Does he recommend a gun, does he propose a gun, or does he *des*cry a gun, the most momentous consequences, to the public, may follow from his act. Such a man cannot, therefore, hope for exemption from criticism; he should, on the contrary, lay his account with severe criticism, because his act concerns one and all of us, and it may be eventually the honour, if not the independence, of the country. Whatever may be thought of my criticisms, I am entitled to claim for them that I have no personal animosities to gratify, nor any private interests to serve. I went to Shoeburyness under the sanction of Lord De Grey as the accredited representative of the *Morning Herald* and the *Standard* newspapers, and now that the privilege has been, I hope only temporarily, withdrawn, it is reasonable and proper that I should look through my note-books, and supple-

ment the substance of my reports with occurrences and reflections which, in the haste of writing for the morning press, were not embodied in them.

London, 11th March, 1865.

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SHOEBURNESS.

CHAPTER I.

THE PLACE.

My First Visit.

On the occasion of my first visit to Shoeburyness, Mr. George Clarke, the expounder of the principle of rigidity in iron armour, had a carriage in waiting for a small party, of which Mr. Charles Reade, Mr. Thomas Spencer, and I were the members. Away we dashed after the carriages with the representatives of the Admiralty, the Iron Plate Committee, and the Ordnance Select Committee. Mrs. Clarke, seated, knitting, on a roadside log, greeted us. At such a time she could not stay at home, and her womanly interest in her husband's success impressed us all with the perils which attend invention. The four miles from Southend to Shoeburyness were soon accomplished; and, delivering the halves of the invitation cards to a grave subaltern, Mr. Clarke led us to the inspection of a model which he had arranged to fire at, before the rigid target proper passed its appointed ordeal. Terrible indeed is

the suspense of an inventor; and Shoeburyness is chargeable with having prematurely filled—nay, with having cruelly filled, the graves of a few inventors. I shall not distress relatives with a recital of the names. We reached the model target, a single shot at which was to prepare a generous man for good or evil fortune. We were anticipated. The model target had been fired at in advance—officially and unfairly fired at in the absence of the inventor—and neither at the moment, nor for some time after, was it suffered to transpire at what range, with what charge, and with what shot the model had been riddled. Mr. Clarke was deeply pained; Mr. Spencer said the officials had acted badly, and Mr. Charles Reade hoped “It is never too late to mend.” I merely remarked that the postponement of official mending is a superfluous and flagrant evil.

Looking About.

Leaving Mr. Clarke to his cares, and my companions to the freedom of their wills, I took advantage of my first visit to look about. Shoeburyness is a dreary place; so dreary that less than ten years ago it was little more than known. Its so-called discoverer is Mr. Hale, the well-known improver and inventor of rocket-stands and rockets.* He was at a loss for a place to experiment with rockets, and the authorities commissioned him to inspect the east coast for one. Shoeburyness was first visited, and, I believe, Suffolk, Norfolk, and Lincolnshire afterwards. Reporting to the authorities, Shoeburyness was the choice, because of its proximity to town. At Shoeburyness, therefore, Mr. Hale fired his rockets; and for some time afterwards the

* Although I have seen some very good practice with Mr. Hale's rockets at Shoeburyness, I have said nothing of them. Those wanting to hear what Mr. Hale has to say of the comparative merits of rifled guns and rotary rockets may consult the treatise on the subject published by Mitchell, Charing-cross, 1863.

place was officially forgotten. It was without attraction, unless for whitebait fishing at Midsummer, rabbit shooting in the autumn, and duck shooting in December. Along the margin of the sea, sand-knolls of irregular elevation and varying breadth, sustain perennial wild grass ; so coarse as to be used occasionally in the manufacture of mats and brooms. Seaward, from the margin, stretch the broadest and most sterile foreshore perhaps in England ; on which oyster spat falls not ; on which winkles, cockles, and mussels breed not, and are only found as castaways. The Southend fishermen have a legend on the subject, which is, that since the invention of gunpowder, and the firing of guns at Sheerness and Shoeburyness, marine life has been chased away. The mussel and cockle interest would not suffer greatly were the Shoeburyness foreshore reclaimed from the beach to the Maplin Sands, and irrigated by the abundant sewage at the disposal of the Metropolitan Board of Works. On the Shoeburyness foreshore, seaward, there are ranges extending from eight to twenty miles, on which a troop of Royal Artillery markers record the grazes of shot and shell. Poor fellows, theirs is a hard lot ; the humid and insidious east wind sapping the stoutest constitution, if not absolutely ending life, in little more than a year from the time that marking is assigned for duty. On the Shoeburyness foreshore, the War-office should have long since laid out a markers' burial-place, with useless inventions in guns, targets, and projectiles to show the resting-places.*

* One of the earliest questions asked me by one of the Shoeburyness officials was, whether, if range-marking is to go on for ever, it would not be better to get life-sentenced convicts or criminal lunatics to perform the duty, instead of well-behaved, high-priced soldiers. I replied that it would be better, but that it would be contrary to precedent and routine ; and that it is preferable to kill any number of soldiers on the ranges than to think of innovation at the Horse Guards or the War-office.

The Marsh, Downs, and
Quarters.

Behind the sand-knolls are the Marsh
and Downs. Both are inconsiderable.

On the Downs a rabbit *battue* takes place annually before the Christmas holidays, and several hundred pairs are distributed among the married officers at the Royal Artillery depôts. How the slaughter is conducted is not known; the Ordnance Select Committee, or the Armstrong and Whitworth Committee, never having pushed absurdity so far as to test competitive guns and projectiles at rabbit killing. Once, it is said, the point was mooted, but silenced in consequence of a wag insinuating that it would answer quite as well were Sir William Armstrong and Mr Whitworth backed at rabbit eating in the mess-room. Beyond the Downs and Marsh the ground rises gradually until, at some twelve hundred yards from the beach, the height is fifty feet above the spring-tide level. But the easy elevation has in parts occasional rolling breaks with lean plantations along the roads and ridges, intended, no doubt, to check and soften the fierce winds which blow so often on the coast. On the crest of the most pleasant slope stands the house of the Commandant, and near by the houses of the senior officers; the Commandant's being worth £100 a year, and each of the others £50. Behind those houses, and separated from them by a short avenue and road, are the barracks of the station—new, tidy, and convenient, but on too small a scale.* Flanking the barracks on the left are the school of gunnery and the guard-house; and on the left, flanking the residences of the Commandant and the senior officers, are the mess-room, reading-room

* So absurdly small is the barrack accommodation, that during the busy part of the Armstrong and Whitworth competition a considerable number of artillerymen and horses were under canvas, there being no accommodation for them. I mention this to show that if anything great is ever to be made of Shoeburyness as a military station, the greatness will have to be created—by money votes in Committee of Ways and Means.

and library, and the quarters of the unmarried officers. The mess-room has the appearance of a small Presbyterian chapel; and internally, when the cloth is laid for dinner, it is again a Presbyterian chapel at the communion season, with the chairman or president of the mess officiating. The quarters of the unmarried officers are disreputable, worth in weekly rental about one and sixpence each. Each of the shanties would form a bad pony stable, an indifferent refuge for a railway watchman at a level crossing, a tolerable small family coal or wash-house, an unexceptionable wine cellar, a superb marine store for a Whitechapel Abraham. A remarkable fact in connection with the unmarried quarters is, that none of the bachelors, although frequently contemplating it, have ever actually committed suicide. Occasionally the razor has been sharpened, the cord adjusted, and the pistol charged, but invariably the rash act has not been consummated. On second thought there has been an adjournment for a stimulating or tonic something from Serjeant Cox, the messman; or a hasty ride or drive to Southend to hear the nightingales.*

The Enclosures and Drill-ground.

Between the superior and inferior quarters and the Marsh and Downs there is a superabundance of enclosed and unenclosed lawn, on which a few milch cows and sheep are at times pastured. One unenclosed space is the parade and drill-ground, skirted in the rear by one-story offices, shops, and stores, flanked on the left front by mortars,

* The nightingales are first heard in England from the shrubbery at the side of the Royal Hotel, Southend. Those with a bedroom in the Royal Hotel towards the sea may enjoy the sweet notes throughout the night, if they care to keep awake—or can keep awake, which is not probable in a place where corn, wine, and hospitality so much abound.

howitzers, and old-fashioned field ordnance, and on the right front by a battery.

Near the battery, but on a considerably lower level, is its magazine, with the entrance from and not towards the battery; and near by are piles of experimental shot and shell of almost all patterns and all calibres. Close to the magazine and battery is the rack of guns, on which, among others of less or more interest, is one of the early guns of the Manchester Ordnance Company, which Mr. Whitworth represents. The whole cloth principle of construction gave rise to a new sensation little more than a year ago, but now it is racked in peace and solitude among the other great guns that were; furnishing a new illustration of the proverb that the worst causes are usually the most noisy. Last of all, close by the rack are the piles of recovered shot and shell, which have been fired on the foreshore ranges, and brought in afterwards by waggon.

The Batteries and Plateau. The battery just named, on the right front of the parade and drill-ground, is the most easterly of all. Its position is on the crest of a plateau or sea wall fifteen feet above the foreshore level. The same plateau or sea wall fringes the high-water mark in a westerly direction, along the entire front of the station towards Southend; and it is from platforms on the plateau or sea wall that all firing takes place on the foreshore.

Such is the ground-plan of Shoeburyness. The barracks, the quarters, and the mess-room occupy the best positions. For the firing on the foreshore ranges there is, as just remarked, the extensive plateau or sea wall; while for the target and shot and shell trials there is the Marsh. The sea front is nearly a mile in length,

the greatest inland breadth being nearly a mile also; the Shoeburyness possession of the War-office has an area of as near as can be one square mile, irrespective of the foreshore. But several of the adjoining farms are said to be held under a special understanding with the Crown, the tenant-farmers being considered ready to vacate on short notice, if their land is wanted for extended ranges, and subject to quit temporarily in case of dangerous shell firing. On one occasion, I was struck by the apparent ease with which the Commandant extended the bounds of the station. Standing on the Marsh one day, one of the early days of the Armstrong and Whitworth trial, Colonel, now General Taylor, loud enough to be heard by all present, instructed Mr. Hopkins, the clerk of the works, to give notice to certain parties that their land would be required. The tone, however, was one of deliberative hesitancy, as if to invite objection on the part of Mr. Hopkins; but he, in his quiet way, merely said that the necessary steps would be taken. If the power to acquire valuable farming land at will for the public is possessed by the Commandant, there is no saying what the eventual area of the station may be, unless the right is seriously called in question. Various assumptions of the kind, not by General Taylor, but by others, to which attention need not now be called, go to show that the theory of personal responsibility is carried out pretty fully in the army, and that it is open to much abuse.

The Targets on the Marsh. Prominent among the attractions of the Marsh are the targets. Some are mere school-room black-boards of various sizes; others, the more or less perfect remnants of armour-plated fabrics. The latter are the targets which tell tales, make men's knees

knock and their teeth chatter; the former neither make nor unmake reputations, unless as showing whether the gunner is malicious, blind, or muddled, because a gun deserving of recognition or a carriage should always lodge projectiles in an object more plainly visible than a cow or horse. The armour-plated targets are ranged on the Marsh facing inwards in regular or irregular lines, with the plateau or sea between them and the foreshore. Fronting the particular target to be fired at are the battery of guns, the piles of shot and shell, and the hand-barrow field magazines. Flanking the particular target to be fired at are also rude bomb-proofs, some of mud, some of the remains of old targets, and one of frightful unsightliness, which may have been a fish-house, a boat-house, or a public slaughter-house for the surrounding villages. Into the frightfully unsightly one the majority of the target firing sightseers crowd, whenever the range is cleared and the bugle sounds attention. Why the majority make choice of the one in preference to the others is because the others are labelled "The Iron Plate Committee," "The Lords of the Admiralty," or "For the Committee only." Under cover of the aforesaid slaughter-house, boat-house, or fish-house, the strictly unofficial therefore go, or move to a safe distance from the armour plate and shot or shell splinters. A word or two of description will not be amiss. The entire face of the unsightly bomb-proof, looking towards the south-east, is a brick and mortar archway, and it is from the south-east that the Essex death-wind blows. One of the side walls, looking towards the north-east, possesses likewise an open but lesser archway. The end wall opposite the entrance archway has in addition a ragged breach at the base, which has been partly filled with the remains of targets

in such a manner that two or more curious and daring persons may watch the firing from the battery. Thus a more draughty and unfit shelter could not possibly have been sanctioned or provided. But draughts are not the only evils against which to record a passing protest. Occasionally the place is a smithy for the repair or adaptation of the iron fittings of the targets; and at such times it is well filled with the disgusting smoke of an unchimneyed hearth. Then, within ten yards or so, stands the *cabinet de naissance*, with five or more years' accumulation. On a close or humid day, and especially when the wind is from the east, the smell is nasty. Between the smell and draughts, attendance at the target trials is a treat which few will be inclined to envy, particularly when it is added that it has happened—and happens often—that there are incarcerations of the sight-seers for an hour or more. The incarceration may have arisen from some misunderstanding at the battery, from some want or other requiring to be supplied, or from the range becoming unsafe by a succession of passing vessels. So, should the officer in charge of the firing have got out of bed from the wrong side that morning, forgotten to take blue pill the previous evening, or by accident had his corns trodden on, there is no escape from the slaughter-house, without incurring the risk of splinters from instant firing, or of being lectured by some boy-subaltern fresh from school at Woolwich.

Inside the Slaughter-house. Inside the slaughter-house the gatherings for shelter are democratic. The labourers who erect and strip the targets are always there, and occasionally they squat and partake of fat pork, home-made pie and bread, and a preparation of gin-and-water. The gin smells gratefully, considering the

proximity of the *cabinet de naissance*, with its fœtid accumulation. The fat pork, especially when the Essex death-wind blows, reminds one of its suitability for labourers in such a place—it being the staple article of diet among the Canadian lumberers in the backwoods—and suggests the unfitness of the present range-markers' food. Near the labourers are a stray soldier or two, ambitious to rub elbows with their betters. Then there is the mass of *savants*, semi-officials, inventors, ironmasters, and others, looking vacantly through the large or small archway, shaking their legs or drumming their feet to promote circulation, or gossiping promiscuously with those they never saw before and are not likely to meet again. At the entrance of the major archway is the subaltern in charge of the *savants*, semi-officials, inventors, ironmasters, and others, who, if in good humour, retails the small talk of the station to those hungry for it, and who, if in ill humour, needlessly prolongs the incarceration after the splinters have been heard to fall. And the splinters sometimes fall in sufficient numbers at the sides, in the front, and on the top, to justify precaution: but certainly not the precaution of saving the bacon of people from splinters at the expense of sapping their constitutions, by exposure to the compound draughts of the three openings—and the smell.

The Preliminaries of
Target Firing.

The preliminaries of target firing are not devoid of interest. In the first place there is a deal of deliberation, and in the second place a deal of bungling, notwithstanding the deliberation. One case of the latter will suffice. Usually, when the Admiralty are interested in a target trial, a special Admiralty train—so called—leaves Fenchurch-street station at nine o'clock, and returns at an agreed-on

hour in the afternoon — each passenger paying five shillings, and the Admiralty, rather needlessly, contributing twenty-five pounds extra for the otherwise well-paid accommodation. On one particular day a target specially constructed for the Admiralty was to be fired at, and it was taken for granted in Whitehall that Lord Clarence Paget, Mr. Stansfeld, or Admiral Robinson had ordered the special train in the usual manner. But neither had ordered the train, and no one else had done so. The representatives of the Admiralty accordingly arrived at Fenchurch-street station after the ordinary train had left, to be told that the next ordinary train would reach Southend a few minutes before one o'clock. An extraordinary special train was of course thought of and ordered, but there being no spare engine at Fenchurch-street station, and none at Stratford with the fire lighted or the water hot, the representatives, after an hour or more of fruitless consultation, countermanded the order for the extraordinary special train, then on its way to Fenchurch-street, and drove home in cabs. Major Dyer took the next ordinary train to Southend to represent the Admiralty, and arrived at Shoeburyness shortly after the target trial had closed. The deliberation preceding a target trial is even more formal and considerably more tedious than the delivery of an orange in a Belgian hospital. There is first the proposal for the target, the submitting of the proposal to the proper committee, the amendments of the committee to be remitted to the proposer, the reply of the proposer to the amendments of the committee, a reference or consultation on points of difference, the ordering of the target, the supervision of the construction of the target, the removal of it perhaps to Woolwich or somewhere else before it gets to Shoeburyness, the reported arrival

at Shoeburyness, the reported erection at Shoeburyness, the determination of the knotty questions of the guns, charges, shot and shell, to be used, the correspondence about something being wanting, the correspondence arising out of the wishes or convenience of some one, and an endless number of other things. Really it is a wonder that the meshes of the net of form are ever passed, a shot fired, or a result obtained. On the arrival of the experimentalists on the ground, the target is visited, and hasty drawings are transferred to note-books. After each round the experimentalists rush from the slaughter-house or elsewhere, and on their note-book drawings trace the separate effects on the target. The secretary of the committee conducting the experiments measures each indent, crack, or surface of destruction, and, naming the measurement aloud, those desiring it may compile a record.

Stripping the Target. The stripping of the target fired at does not begin until the experimentalists have gone away. Then the labourers set to work, the armour plates are removed, and the actual extent of the injury ascertained. The task is necessarily tedious and uninteresting, and for scientific purposes entirely useless; it being with a penetrated target much the same as with a dead soldier,—a matter of no importance whether he received the fatal blow in the head or heart. The target bolts occasionally undergo reconstruction in the smithy within the slaughter-house.

The Foreshore Targets. The foreshore targets, with two exceptions—the exceptions being the two floating Warrior targets—are school-room black-boards. At ebb-tide, when the range is clear, the black-boards are loaded on a

waggon and set up on the sands, with slender rear supports, the intention being to ascertain how near the target is hit, or how many fragments of projectiles have penetrated, or merely lodged. To the sands there is no rush of experimentalists after each round, and the results are only known after the firing has ceased and the targets have been brought to the parade and drill-ground in front of the office. Nor when firing at targets on the foreshore are the experimentalists or gunners under cover, because there is then no danger from return splinters. When foreshore targets are fired at for length of range or accuracy, the results are readily obtained by a short measured pole in the hands of the range-markers; the range from the batteries outwards being staked in yards for miles. The foreshore firing and the marsh firing are both often tested for velocity, the shot striking a wire screen near the muzzle of the gun for initial velocity, and distant screens for the intermediate or final velocity. The wires of the screen indicate the force of the passing shot on an instrument of great delicacy, and by that means the velocity is determined. As a rule, the targets on the Marsh are photographed before firing and photographed after firing; the black board foreshore targets are only photographed after being brought in when importance attaches to them. At the War-office the photographs are bound in volumes, and as the negatives are preserved, the libraries of the Houses of Parliament and the public institutions might be at any time supplied at little or no expense. Members of either House moving for papers relative to target trials might ask the photographs of the trials, in cases where the effects require to be pointed out. A precedent for so doing is to be found in the United States reports of the Patent-office.

The Field Works.

The field works are a noteworthy feature of the place. They are partly on the Marsh and partly on the Downs, and intended to illustrate that part of the study of the artilleryman at the school of gunnery. The work on the Marsh forms two sides of a square and has no ditch. Those on the Downs are two in number—one a regularly formed field work, the other a three-gun embrasure, with parapet, slope, berm, scarp, ditch, palisade, counterscarp, and *abattis* in the front. To the left of the former work there is a sheet of water, over which bridges are occasionally thrown, and on which guns are sometimes mounted on cask platforms. While speaking of the sheet of water it may be well to state that the French have an excellent rule of turning such water as they possess for like purposes to a sanatory use. The French soldiers bathe. So fine a sheet of water as the one at Shoeburyness, which may be renewed from every tide, ought also to be made the most of.

The Defence.

With the field works the permanent objects of interest are exhausted. There are, however, some exterior topics on which it will be well to touch briefly. Foremost among the number is the question of the availability of Shoeburyness for the defence of the Thames. For such defence, or for any defence, Shoeburyness is of no use; the reason being the extensive foreshore. Over the seaward foreshore the heaviest guns ever likely to be forged would not throw projectiles, and, therefore, as far as Shoeburyness is concerned, the Thames will always invite attack. Permanent fortifications for the defence of the Thames are only possible on the Kentish side—until at least the foreshore of Shoeburyness has been reclaimed and rendered fertile

by London sewage. Then batteries on the Essex side would be possible. But, as it is held by artillery officers to be unnecessary to possess batteries on the Essex side, let it not be supposed that an argument is being put forward here for the reclamation of the Shoeburyness foreshore. What is here stated is, that the defence of the Thames from the Essex side is only possible by such reclamation, without offering an opinion on the sewage question.

The Nuisance.

The one other topic that may be worthily noticed is the nuisance which Shoeburyness occasions to Southend and the neighbouring villages. Before the establishment of the station, Eastern Essex was virtuous and happy; and the station is not yet of long standing. The virtuous period that was, and the profligate period that is, are both therefore in the mind's eye of all decent Eastern Essex people. They were witnesses of the good, and now they are witnesses of the evil. To them, the present state of things is a reflection on the army.* Grounds which have been laid out for pleasure, cliffs with attractions for residents and visitors, are polluted by soldiers and officers. Within a few yards of a row of superior dwellings Shoeburyness is responsible for habitual displays of blackguardism which would confer patents of nobility in the Sandwich Islands. The neglect of the War-office

* Between the ordinary officer and soldier blackguardism of a garrison town and the Southend officer and soldier blackguardism the difference is striking. At Southend there appears to be neither moral nor military restraint, it being impossible for a female to be abroad at any time without being followed or insulted by gesture or conversation. Some time ago it was proposed by some of the inhabitants of Southend to appoint a committee to visit the London houses of a class and point out to the inmates the advantages of settlement at or near Shoeburyness. That course is still in contemplation as the only escape from excesses which are indulged with no sense of shame.

in not providing better for the unmarried officers is no doubt to some extent to blame. Of course, all the men and officers are not blackguards. Among the married there are even a few of obtrusive piety.

Rejoining my Companions.

Rejoining my companions, Mr. Clarke was greatly chap-fallen. He had failed, and, like others, might be excused for saying that he had not been treated fairly. It was amusing to watch the consequent exhibitions of the baseness of human nature. The men of all ranks and classes who had not seen the model target, and who had sworn by the principle of rigidity before the firing—as embodying their own unexpressed and unworked-out convictions—now hid their heads. They had been caught napping. They did not now rejoice in the acquaintance of Mr. Clarke, and denounced the rigid target as a gross imposture. The disinterested observers present would have thought all the more of Mr. Clarke if he had taken to punching heads or kicking promiscuously with his boots.

Luncheon and Home.

After the riddling of the rigid target the sightseers repaired to a tent to partake of a horse-fair repast, provided for by a gracious Parliament in the Army votes. It was my first official meal, and I was late. Mr. Clarke was at table, receiving the dry nursing of Commander Scott. The plates were all dirty, the knives and forks all in use, or they had been in use. Tipping half-a-crown to a red waistcoated waiter led to an immediate towel-wiping of knife, fork, and plate and an abundant supply of good things, such as they were. Noticing next morning in my report the dirty manner in which men of science took their meals, the horse-fair

practice was shortly afterwards abandoned. Emerging from the tent, the carriages were in waiting, and a twenty minutes' trot and gallop brought the crowd to the Southend railway station. It will be interesting for those to learn who at present suffer from the disgracefully slow travelling between Fenchurch-street and Southend that the home journey, like the down one, was accomplished within the hour.

CHAPTER II.

ITS ORGANISATION.

What it Is.

The organisation of Shoeburyness is of a threefold character. It is a military station in the same sense as Gibraltar, Malta, or Bermuda; a school of gunnery in the sense that the London Hospital is a school of medicine; and an experimental ground for ordnance in the sense that the yard at a livery stable is an experimental ground for horses. The experiments have their responsible and directing head; the school of gunnery has its responsible and directing head; and the military have their responsible and directing head. The military proper may be called on to assist in the experiments; but there are special detachments for the duty; and with the school of gunnery neither the special detachments for the experiments nor the military proper have anything to do. In a word, the organisation is in three parts, each practically distinct and independent of the other; and the Commandant is the medium of communication with the War-office and the Horse Guards for the three. The Commandant is besides charged with carrying out the unrevoked orders of the Secretary of State for War. Conscious that the post of Commandant was a mere sinecure, to which the attention of Parliament might at any time be called, Lord De Grey recently, on the promotion and removal of General Taylor, reduced the allowances some £400 per annum. There was then difficulty in finding an officer to take the appointment, it

having been formally declined by several, but at last the officer who had previously succeeded General Taylor in Canada occurred to some one, and he accepted. It will be seen hereafter that the interests of the newspaper press, and therefore the interests of the public, would have been better served either by the office of Commandant being annulled, or by a high-priced officer succeeding General Taylor. Since the appointment of Colonel Wilmot to Shoeburyness, there has been a revival of military martinetism, approaching to martial law, particularly as regards all civilians; and if Colonel Wilmot is not responsible for the farce—it really is a farce—he will lose nothing, but deserve respect for saying so. What has taken place to the prejudice of the newspaper press and the public will be stated when the case of the public comes to be considered.

A Peculiarity in the Organisation.

There is a peculiarity in the Shoeburyness organisation which places us Englishmen on the level of the Turks, as administrators in public matters. The Sultan commands; and Lord De Grey commands. As in Constantinople, so at Shoeburyness, the command may have ceased to be applicable, or it may be absurd; but as it is the command of the Secretary of State, it is for officers and soldiers to obey. Will it be believed that when any question arises—the question, for example, which has often actually arisen, whether the Commandant is to serve those who conduct experiments, or they who conduct experiments are to serve the Commandant, the Commandant, if he is obliging, will concede what is asked, but if not obliging will refer to the instructions under which the station was established, because then he can be as unaccommodating as he likes. A recent case of the kind created a sensa-

tion among the Shoeburyness officers. It was this. In the Armstrong and Whitworth competitive programme it was provided that the competitors were to demonstrate the rapid firing qualities of their guns by officers and men of their own selection. The Manchester Ordnance Company, represented by Mr. Whitworth, had their trial; and Sir William Armstrong telegraphed to Ireland for Lieutenant Reeves, an officer on leave, who, as assistant-superintendent at Shoeburyness, has had more to do with the Armstrong guns than almost any other person. Sir William Armstrong desired that the rapid firing of his guns should take place under Lieutenant Reeves, and Lieutenant Reeves accordingly came to Shoeburyness. Colonel Wilmot referred to his instructions, and of course could not find it stated that Lieutenant Reeves might return on leave from Ireland to do anything of the kind. Lieutenant Reeves therefore left again on leave, not having been allowed to do that which he was prepared to do, that which he might have done with propriety, and that which it was desirable he should have done as a matter of fairness between man and man. Constantinople might match the case of Lieutenant Reeves, but it could scarcely exhibit anything more calculated to bring its administrators and administrative system into disrepute. That Colonel Wilmot was justified by his instructions in what he did is indisputable; but it is monstrous if the off-hand memoranda of a minister are at such a place as Shoeburyness to receive a literal interpretation; outrageous if at the only place where artillery experiments may be said to be conducted, reasonable compliances are not accorded on the instant. Adherence to routine at Shoeburyness has blasted the well-founded hopes of many, and inflicted superfluous injury on almost every one who has had to do with the

place. It is to be hoped that Lord De Grey will take an early opportunity of examining and re-modelling the instructions of Colonel Wilmot.

The Military Station.

It having been already stated that the foreshore renders Shoeburyness unsuited for defence, the inference therefore follows that as a military station it might be dispensed with; Sheerness, on which will always rest the burden of the protection of the Thames, requiring all the artillerymen who can be spared. But it is probable that when the founding of the station was proposed, it was in contemplation, at some convenient time, to incorporate the station with the gunnery school, or the gunnery school with the station, and the carrying on of the experiments with both. If such an arrangement was ever thought of, the first step has yet to be taken towards the incorporation. Immediate action in the matter may be here urged on the authorities. And not only is Shoeburyness indefensible as a military station, but any scheme of incorporation would be incomplete unless artillery recruits, instead of joining the Warley, Woolwich, or Sheerness depôts, were required to drill at Shoeburyness; gunnery instruction being even more necessary than gun drill and marching drill. The propriety of the change is felt and acknowledged by all Artillery officers capable of thinking on the subject. The present practice makes the artillery recruit a mere infantry soldier at six months' end; nothing more. He is not an artilleryman. And what is worse, he is practically without the opportunity of being an artilleryman until he has become a non-commissioned officer. It happens that from the depôt the young artilleryman goes abroad, and it is found that he returns afterwards to England, and may even remain in England until dis-

charged, without learning that which he should have acquired at first. In this neglect of gunnery instruction is to be found the explanation of the fact that as a rule the fire of artillerymen is slow and ill-directed, while that of seamen is, as a rule, rapid and effective, although artillerymen fire from a steady platform and sailors from a ship. Our seamen receive gunnery instruction, and serve their guns as guns should be served.*

Soldiers and Sailors.

Between the soldier and the sailor there is a difference which, although obvious to most people, appears to have escaped the attention of our rulers. The sailor, from the first day he makes choice of his occupation and appears on board ship, is put on his metal; he must accommodate himself to the motions of the ship on deck and aloft, and some of the duties he is called on to discharge demand both address and skill. The soldier, on the other hand, from the day he takes the shilling until the day when he is discharged, may have little more to do than square his toes, set up his shoulders, and use his legs mechanically. To the end the soldier may be what he was at the beginning—useless out of regimentals. The polish put on him is different in kind from that put on the sailor—the sailor is mentally exercised, even although he never learns the alphabet: mind ranges no higher in the army ranks than the attainment of that smartness which is most in esteem with nursemaids. The soldier is a machine; the

* Gunnery, however, in our navy is a year or two behind gunnery in the French navy and in the navy of the United States. The French have long had an excellent system of practical gunnery in the fleet; we have had partial instruction only, and that not always of the best kind. The Americans have had during four years the best of all teaching—that of war; and the information I have received on the subject justifies the statement that the Americans are as greatly in advance of the French as the French are in advance of us. I believe that gunnery in America has been cultivated until perfection has almost been attained.

sailor a man versed in weather; in the constant exercise of the severe discipline of the wheel, which requires the keeping of his ship's canvas full, and his ship's head to its course; and with the responsibility of the look-out for ships, lights, land, or breakers. Gunnery instruction comes therefore easy to the sailor—so easily, it is said, that the men of the Royal Naval Reserve are to become good gunners with a single month's training, spread over a whole year. And those who have watched the progress of the Volunteer Artillery bear much the same testimony to the manner in which the science and art of gun laying are mastered by the right sort of men. Indeed, as matters stand, it is not improbable that were the country to become involved in a great war—a civil war in Ireland, for example, with an American* or French army establishing itself on the Hampshire or Irish coast—the Royal Artillery would be less efficient either in the field or in garrison than the Volunteer Artillery; although the former would prove greater adepts at mounting and dismounting guns, throwing up works, and laying platforms than the latter. No Volunteer Artilleryman of spirit fails to make himself more or less acquainted with his whole duty, and it is the case that when a gun has been laid on an object each Volunteer's eye in turn tests the accuracy of the aim.†

* I may confess to being one of those who believe in the ability of the United States to cover the landing of a greater body of troops in Ireland than we would find it easy to cope with. The Americans might oppose six ironclads to our one; and the American ironclads would fire 100lb. of powder against our 16lb. with the 68-pounder. It does not seem to be generally known that the American Monitors are mere unfinished ships for an Atlantic voyage; and that a slim iron top-side would bring them safely to anchor off Queenstown or in the Mersey. I have reason to know that this ultimate adaptation was originally considered.

† I would be the last to depreciate the training of the Volunteer Artillery, for at the origin of the Volunteer movement the knowledge I possessed of the organisation, effectiveness, and orderliness of the American Militia was freely used in the furtherance

Perhaps the knowledge of this fact in official quarters is an obstacle in the way of the proper training of the Royal Artillery. If so, it may fairly be assumed that it would be unsafe to count on the Volunteer Artillery taking the field in case of civil war or invasion—because the Volunteer Artillery would discover that, through official supineness, they were duped into being the real defenders of the country. The Volunteer Artillery are in positions of life—and the same is true of all Volunteers—which would not admit of their taking the field or going into garrison as soldiers; and therefore the Royal Artillery should be placed on such a footing of efficiency that, beyond furnishing temporary local aid, the Volunteer Artillery would not be counted on. Practically for national defence it would be quite as well to disband the Royal Artillery as to continue it in its present defective organisation.

The School of
Gunnery.

We have only to turn to the School
of Gunnery for convincing corroboration.

There are three courses of instruction in the School of Gunnery * :—

First—The long course for officers and non-commissioned officers. The course lasts a year, from April to the end of March, with a month's holiday at Midsummer and another at Christmas. Instruction is

of the patriotic cause. But I am bound to state that the training of the Volunteer Artillery is not the best attainable for the defence of the country. It is incomplete, and must necessarily continue incomplete. Scepticism on the subject will be set at rest by the perusal of any good artillery hand-book.

* It may be well to state that the information about the School of Gunnery courses was communicated to me confidentially at Shoeburyness. It is literally correct, and I regret being precluded from giving my informant's name. The information was given in the hope that as soon as the facts are known something will be done to rescue the Royal Artillery from the deplorable condition of inefficiency into which it has fallen. Before the Crimean war an Artillery officer was not expected to be able to drill his men: at present it is optional whether he learns his profession fully; while privates in the Artillery are not artillerymen at all.

imparted in the manufacture of ordnance, ammunition, &c., and in the serving, moving, &c., of all ordnance; in practising with all "natures"; in bridging; in the construction of field works; in the embarking and disembarking of guns; in infantry battalion drill; in fact, in all the duties of an artilleryman as laid down in the hand-book. Twenty officers and thirty non-commissioned officers are the respective numbers usually attending the long course.

Second—The short course for adjutants and other officers of Militia Artillery, sergeants of Militia Artillery, and any officer of the Royal Artillery who can be spared from his battery and may apply to join. Non-commissioned officers stationed at Shoeburyness who can be spared are also eligible for instruction. The number in all passing the short course ranges from twenty-five to thirty, and, the course occupying three months, there may be three courses in the year. The short course is an abridgment of the long course, without battalion drill, bridging, &c.

Third—A short course in Armstrong drill, lasting about a fortnight, for officers on leave from abroad or on duty in or near England, who may have had no opportunity of learning rifled-gun drill, and receive the permission of the Adjutant-General.

The courses commence from time to time according to the number of officers who apply. The inducement beyond the scarcely operative one of mastering the profession is, for the long course, the deferred hope of the officers becoming instructors of gunnery, and the non-commissioned officers assistant-instructors to brigades. The short course merely confers certificates. The third course, inasmuch as it is supposed to give the instruction which all should receive, is unacknowledged.

The only other schools are—

First—The Arsenal School at Woolwich, in which there is a course qualifying officers to become inspectors of warlike stores at out and other stations.

Second—The Royal Artillery Institution at Woolwich, in which instruction is given in languages, the sciences, mathematics, photography, &c.

The Inference from
the Facts.

The inference from these facts obviously is, that gunnery instruction is in a much less satisfactory state in the Royal Artillery than is generally supposed. There is a very limited demand for gunnery instructors of brigades, because recruits and privates—the latter being misnamed gunners—are not supposed to require such instruction, and, the appointments being all filled, the inducement of remote benefit alone remains. The crop of skilled artillerists is, therefore, a very small one, and not at all promising. If we turn from that conclusion to the state of some of the Artillery brigades with old-fashioned ordnance, and to the disposition or disposal of the entire force, it will be impossible to gainsay what has been stated—namely, that as matters stand, the Volunteer Artillery are, in truth, the real defenders of the country—so far as the Artillery can be defenders—and that the time has come when the establishment at Shoeburyness, if preserved at all, should be turned to business-like account, in imparting to Artillery recruits that essential knowledge which at present is withheld. I believe the expense of the change to the country would be very trifling. It would at least be an expense that the country would be better able to bear than the present waste.

The Artillery Brigades. There are six Brigades of Royal Horse Artillery—A, B, C, D, E, F.* These six Brigades comprise thirty-one batteries in all, each battery consisting of 180 men and 132 horses. Three of the Brigades have 6-pounder and 9-pounder Armstrongs; the three others are still in possession of the old-fashioned arms. Four complete Brigades are in India—C, D, E, F; and so are two batteries of the A Brigade. Eight batteries only are therefore available for Europe and all other parts, twenty-three batteries being required in India. Horse Artillery act with cavalry in the field, the gunners being all mounted.

The Field Artillery comprises eleven Brigades—the 4th, 8th, 9th, 11th, 13th, 14th, 16th, 17th, 18th, 19th, 23d. The Brigades average eight batteries, with one hundred men to each battery. The first six of the Brigades have batteries of 6-pounder and 12-pounder Armstrongs. The last five of the Brigades have batteries of old Indian artillery. Seven complete Brigades are in India, leaving only four Brigades for Europe and all other parts. There are besides two mixed Brigades in India, the 20th and 22d, partly Field Artillery and partly Garrison Artillery. Field Artillery act with infantry in the field, the gunners riding on the guns.

The Garrison Artillery comprises twelve Brigades, the 1st, 2d, 3d, 5th, 6th, 7th, 10th, 12th, 15th, 21st, 24th, 25th. The Brigades average eight batteries, with one hundred men to each battery. The guns of Garrison Artillery are usually the guns of the station where they are quartered. Three complete Brigades are in India—the 21st, 24th, 25th. There are, besides the two mixed Brigades in

* The stations of the Royal Artillery are taken from the sole authority in such matters—*Jackson's Woolwich Journal*. The journal is published monthly, and the copy made use of by me was for December, 1864.

India already named, the 20th and 22d, partly Garrison Artillery and partly Field Artillery. One complete Brigade, the 1st, is at Gibraltar; one at Malta, the 3d; one at Plymouth and Pembroke, the 5th; two at Portsmouth and the Channel Islands, the 6th and 7th; one at Dover, the 13th; one in Ireland, the 8th; one at Shorncliffe, Aldershot, &c., the 9th; two in America and the West Indies, the 10th and 15th. The Cape of Good is in the hands of one battery of the 12th and one battery of the 2d; Ceylon is also in the hands of one battery of the 2d; and Australia is in the hands of a single battery of the 12th.

Summing up: of the six Brigades of Horse Artillery four are in India; of the eleven Field Artillery Brigades seven are in India; of the twelve Garrison Artillery Brigades three are in India; and the two mixed Brigades are in India. Of a total of thirty-one Brigades sixteen are in India, eight in various parts, and seven in the United Kingdom.

But there is, in addition, the coast Brigade, with its eight batteries, and its officers who have risen from the ranks. There are thus, according to the present disposition of the Artillery, eight instead of seven Brigades available for the defence of England. Eight Brigades each, with eight batteries of 100 men, gives 800 men to a Brigade, and 6,400 men for the national Artillery defence. The consequence is, that at the present time some of the most important fortifications of the country are only held by a sufficient number of men to see to the guns and platforms. We have fortifications without artillerymen, and we are creating additional fortifications without proposing to organise a single new Garrison Artillery Brigade. So far, therefore, as fortifications are concerned, if ever they are to be manned, it must be by

Volunteer Artillery, who certainly never look forward to becoming soldiers. The Volunteer Artillery should think of this, and so ought Parliament and the country.

Volunteer Artillerymen.*

Still, it will be replied by that numerous class of Englishmen who, possessing no information on the subject, never cease to boast of our invincibility, that it is probable the Volunteer Artillery would make whatever sacrifices the exigencies of the times required of them. Admitting that they would, what then? Those who have attended the experimental firing of the most practised gunners at Shoeburyness will bear testimony to its generally indifferent quality, especially at long ranges. The firing at the second floating Warrior target at a comparatively short range, as will be seen hereafter, was really painful to be witnessed by those present, and at the first floating Warrior target it was only possible to get one hit, although the distance was inconsiderable. If such is the character of the firing of the most practised Shoeburyness gunners, there may be more to learn by the Volunteer Artillery than some imagine.

Major Owen's Testimony.

Major Owen's* testimony may be taken as conclusive. Speaking of hitting a steam-ship from a land battery, he says, "As a steam-vessel can constantly change her position and move very rapidly, it is often extremely difficult, when firing from a land battery, even to hit her, except when she is obliged to advance in a certain direction, or has arrived within

* Major Owen's *Essay on the Motion of Projectiles* (Mitchell, Charing-cross, 1862), is the best book on the subject that I have read. One hour's reading will clear up to any one some of the most knotty questions on the subject. Had the book been better known, less mystification would have been possible at the War-office and Shoeburyness.

a very short range." Speaking of the difficulty of judging distance, he says, "The difficulty of judging the distance for laying a gun upon an object at a long range, and of observing the effect of the fire, also the disturbing influence of the wind during a long time of flight, will confine the ranges of projectiles used for military purposes within 2,000 yards, or perhaps in special cases, when firing at masses of troops, ships' buildings, &c., to 3,000 yards." Speaking of the bad practice at short ranges, he says, "It is sometimes assumed that the most accurate practice can be made at very short ranges of 100 and 200 yards, and this may be true for experimental practice; but when guns are in action at such ranges, the firing is always extremely wild, the object being hidden by smoke, and there being too much noise and confusion to allow of careful laying, so that in all probability the practice at 400 or 500 yards in action will be more accurate than at close quarters." Speaking of the difficulties in the way of precision in firing, he says, "In the field the gun carriage rarely stands on even ground, or on exactly the same ground twice. The difficulty of judging distances and of laying the gun is very great, for the objects are generally moveable, and are frequently obscured by dust and smoke. Haste and carelessness in laying the piece are often unavoidable when uncovered guns are served under a heavy fire." Last of all, he assumes that "the ranges over the water in front of the battery would be known to the gunners in the battery."

The Testimony of Others. The testimony of others bears out Major Owen. General Taylor, the Inspector-general of Artillery, has told me that the necessary ignorance of the ranges would operate greatly against the efficiency

of the Volunteer Artillery in the coast fortifications. The Inspector-general—and there are few more competent authorities and few better soldiers—holds to the common-sense opinion that permanent fortifications, to be effective at the proper moment, must be held by men who know exactly where every shot will fall. The precision of the billiard-room or cricket-field may, when present, drive back the enemy, and when absent, the enemy may only be assailed by the whizzing sound of projectiles and the noise of gun-charge explosions. Other Artillery officers reiterate the opinion of General Taylor; but there are also some who fall in with the popular sentiment, and affirm that a trial shot or two is in all cases sufficient to obtain the range. While the trial shots were firing, the golden opportunity may of course have vanished.

Re-organisation Necessary. Thus Royal Artillery re-organisation is imperative. We may delay it for a year or for a dozen years, and come to no harm by so doing, but with the Royal Artillery as it is, the national honour would fare badly in any serious quarrel. As it stands, it is an effete organisation, not worth a fraction of the public money expended annually for its support. It resembles the mailed warriors who lead or follow in the Lord Mayor's procession, inasmuch as it practises the same deception on society as the mailed warriors on housemaids and children. But there is little doubt that the Royal Artillery will be as troublesome to deal with as the Lord Mayor's procession. Both are institutions, and it will be urged that up to the present time we have got along very creditably with them. But truth, nevertheless, is truth; and, while Parliament sanctions fortification schemes, it forgets both the gunners and the guns. It is the case at this moment, that there is not one English roadstead

with a single gun that could be brought to bear effectively against an enemy's ironclad. The 110-pounder Armstrong is the heaviest gun yet mounted ; and although the gun is able by its projectiles to sink any wood ship of war afloat, an ironclad would receive its fire without injury, and force the roadstead. The batteries of 110-pounder Armstrongs at Sheerness, and higher up would cope successfully with any wood fleet which might try to ascend the Thames ; and batteries of 300-pounder Armstrongs would render as good an account of any fleet of ironclads. But who knows when 300-pounders shall take the place of 110-pounders at Sheerness ; or when 300-pounders shall supersede the old-fashioned smooth-bore guns in the embrasures at Tilbury. Tilbury Fort, with 300-pounder Armstrongs, without a single shilling's expense beyond the guns and ammunition, would check, engage, and sink the collective ironclad fleet of Europe, were the fleet to elude the lower batteries. As that is a matter of fact, it is to be hoped that it will receive the attention it deserves. It is to be also hoped that hereafter, when we are to have carts, horses will not be forgotten. All the fortifications which engineers could suggest might be created by the votes of Parliament, but after the question of guns comes the last and superior one of gunners—trained gunners. These we do not at the present time possess, and we are taking no steps to supply them, even for the efficiency of our handful of diffused Brigades. I recommend the rendering of those brigades efficient by the utilisation of Shoeburyness ; and when that has been done, if we are to have fortification schemes, let us at the same time have votes for guns, and votes for new Horse, Field, and Garrison Artillery Brigades. We should know exactly what we are doing, and not by halves or quarters.

CHAPTER III.

THE COMMITTEES.

Have a good Time.

As the Shoeburyness Committees* may have bed, board, and washing at the public charge, it is their own fault if they do not enjoy themselves. And, to do them justice, they make a good personal use of their opportunities. The arrival of individual members is heralded by telegram not less than twenty-four hours in advance, even although at the previous reckoning the hotel-keeper may have been told when his honoured guests may be next looked for. On the receipt of the telegram the sheets are aired, the fires lighted, the larder stocked, the carriages and horses held in readiness, and the head waiter instructed to attend the arriving trains. Stepping on the platform, the honoured guests find their way to carriages, while the hotel porters see to dinner, wardrobe valises, dressing-cases, and despatch-boxes. Arriving at the Royal Hotel, Southend, a smiling landlord and something hot greet them. Then follow the drive to Shoeburyness, and the

* The Committees here spoken of are not the Parliamentary committees which have sat on ordnance, but the professional committees, whose proceedings are not published. The names of the members of the professional committees for several years past will be found under Appendix A at the end. The number of the committees, according to the proverb of "too many cooks," will go far to account for their uselessness, and for the apparently hopeless state of confusion in which their labours have left the questions which it was supposed they were to clear up by investigation.

luncheon at the mess-room, and back to the Royal Hotel, Southend, in time to dress for the seven o'clock dinner. The seven o'clock dinner is superb for forty miles out of town—quite a Star and Garter one in a small way. The President, facing the door and spreading the cambric on his knees, whispers thanks to him who cares for committees, and suffers not a sparrow to touch the ground without his knowledge. After dinner there are the piano and the song, the tobacco, and the stroll along the cliff or beach to inhale the cooling sea breeze. Such is the every-day life of the committees at the Royal Hotel, Southend. Neither count nor care harasses, and when the hotel-keeper wants money, his account is certified and the Quartermaster despatched to Woolwich. During the summer months wives and families are brought to Southend, and the time passes pleasantly; the members of the Armstrong or the Whitworth Companies exchanging dinner treats with the committees. But in addition to this happiness, services so onerous as those of the committees are suitably acknowledged by frequent doles at the rate of £3 3s. daily, including Sundays.

The Serious Duties.

Next to dining in dress coats, white waistcoats, and white stocks, the most serious duty that I have known the committees to discharge has been a little arithmetic. The rounds fired in the course of the day have given results which are scattering—which present first the schoolboy puzzle of finding the mean of a number of sixes and sevens, and second, the agricultural puzzle of putting a mathematical rope fence round the shot enclosure—in other words, round the shot or graze parallelograms. These are sore trials to most men of middle age, especially the parallelograms,

although the matter may be easy enough to any fourth-rate boarding-school monitor. To get comfortably over the difficulty, the Armstrong and Whitworth Committee are chargeable with prudently retaining Professor Pole of King's College. All the mathematical drudgery of the committee has been signed, sealed, and delivered to the worthy Professor with the same formality as the viscera of a poisoned person is made over to Professor Taylor. The advantage of the arrangement has been ample leisure to the committee to dine and receive the dinners of the competitors, hear both sides fully, and determine with judicial calmness. If we follow the Armstrong and Whitworth Committee for a week to Shoeburyness, the nature of their duties will be quite intelligible. The best horses and the best carriages of the Royal Hotel toddle off to Shoeburyness on Monday morning the moment the newspapers are received by the first London train. Between Southend and Shoeburyness the members of the committee skim over the leading articles and the general news of their favourite journals. The carriages draw up in due time at the office of the Commandant, and Major Curtis, wearing his red waistcoat, is at the door. He states that the matter referred to Lord De Grey has not been decided, that the Whitworth shot have not been received at Woolwich, that there are no more targets, that there are no fuzes for the Armstrong shell, that the impressions of the bores of the guns have not been taken, that the sights of the guns have not been verified, that the positions of the guns have not been changed, and that the tide will not serve for firing on the range until after luncheon. By the time that the gallant Major has delivered himself of this long sentence from the orders of the day of the Commandant, Colonel Wilmot, he is rather more

than short of breath : he is completely blown. General Rumley immediately mutters something to Colonel Ormsby ; Captain Wilson mutters something to Mr. Whitworth ; and Major Dyer mutters something to the coachman about an alteration in the dinner hour. Two or three small matters have to be seen to by some members, and it is probable that any of them may have letters waiting at the mess. The members therefore disperse in all directions, and shortly after two o'clock the carriages which brought them from Southend re-convey them back, after luncheon. Such is the Monday's work in the solution of the great Armstrong-Whitworth controversy. The evening is passed pleasantly at the Royal Hotel. On Tuesday morning all the members of the committee whose private affairs have not called them elsewhere for the day, week, fortnight, or month, are set down at the office of the Commandant by eleven o'clock. There is no one receiving them, and no one to be seen or found but the orderly of Major Curtis. Why this is so is because it is no part of the duty of the orderly to ask where the Major is going to, and no part of the duty of a soldier to ask an officer where he may be found an hour or a couple of hours afterwards. The committee divides on the parade or drill-ground, one or two to talk with Colonel Boxer, and one or two to gossip with any popular subaltern who may be passing. At length the Commandant, Colonel Wilmot, turns up, and says it was understood, or supposed to be understood, that there was to be nothing done on Tuesday. Explanations follow, and the joke of the misconception is laughed at all round. The committee and the Commandant stroll from the parade and drill-ground to the battery, and afterwards from the battery to the mess-room. Returning in the cool of the afternoon to the Royal Hotel,

Southend, the committee report progress by telegram to General St. George, at the War-office. After dinner the propriety of a supplementary telegram is generally assented to, informing General St. George that in consequence of the wrong friction tubes having been sent from Woolwich the firing will not be resumed until Thursday morning at ten o'clock precisely. On Wednesday such of the committee as have no private business to attend to in town drive to Prittlewell to see the church, to Hadleigh to see the ruins, or hire a boat and boatman, with bait and lines, for flounder-catching. On Thursday morning there is a pretty full muster of the committee at the office of the Commandant about half-past ten. Sir William Armstrong, Captain Noble, and Mr. Stuart Rendel are present to explain, and Mr. Whitworth, Lord Torrington, and Mr. Aston are present to protest.* Either the Whitworth gun has been washed out or it has not been washed out. A matter of so much importance cannot be decided without reference to Lord De Grey, and an orderly being sent off to Southend to communicate with General St. George by telegraph, the upshot of the washing out or not washing out is that the committee and the competitors are commanded to meet Lord De Grey at the War-office on Friday, at eleven o'clock. While the orderly is absent communicating with General St. George, five-and-twenty rounds of shot or shell are fired from each of the guns for endurance, range, accuracy, or destructive effect. Thursday night is spent at the Royal Hotel, Southend; Friday is spent at the

* It may be well once for all to explain that the competition of the Armstrong and Whitworth guns has not been for the decision of private or individual interests, but of corporation or company interests. Sir William Armstrong represents the Elswick Ordnance Company, and Mr. Whitworth represents the Manchester Ordnance Company.

War-office and in town; and Saturday being clearing-up day at Shoeburyness, is a holiday to all but the cleaners. Such is a fair sample of the Shoeburyness duties. They are by no means calculated to impair digestion.

En Permanence. The good thing of being on a Shoeburyness committee has the natural tendency of spinning out the experiments until the War-office even becomes sick of them. Of course the members of the committees would not until the end of time become ashamed. Fools only fall out with their bread-and-butter, and it is well known that wisdom is the supposed recommendation for a Shoeburyness committee. The Shoeburyness committees are therefore committees *en permanence*; like Sam Slick's clock, they wag perpetually. They are much the same thing as vestry boards *en permanence* would be for parish purposes, or Parliaments *en permanence* for national purposes. After a committee *en permanence* has had half a dozen meetings, each member knows his neighbour's measure, is aware what he will say and think on all occasions, and what he and his colleagues must yield for the sake of harmony and good feeling. As, therefore, the committee can only praise faintly, the faintness is always damning; and as it can only reject faintly, the faintness keeps alive hopes in men's minds which it would be charity to extirpate. Rare indeed are the occasions when there is an approach to cordial unanimity. Seldom has merit been inquired into for its own sake, and supported in its righteous claims. Such a proceeding is calculated to close the labours of a committee, and restore to the obscurity of official indigence those whose interests point the other way.

The Appointments.

The mode of the appointment no doubt tends to the permanence of the committees, and therefore it is in a certain sense true that the mode of appointment is more to blame than the individuals who compose the committees. In the main mere tools are selected by the War-office and the Admiralty, so that the usefulness of any able men serving is restrained by numbers. What the Admiralty and the War-office desire in the appointment of a committee is not a straightforward report, like that of the bills of mortality, but a report which, if possible, shall not appear until all interest in the subject has subsided; a report, moreover, which shall be framed in accordance, or at least not openly at variance, with the views or wishes current in official circles. Accordingly, all Shoeburyness committees are packed committees—packed to discountenance that which it has been decided to discourage, and promote that which some high personage or other has set his heart on. The truth of this statement was never more conclusively verified than in the appointment of the Armstrong and Whitworth Committee, the members, with two or three exceptions, being professionally incompetent to decide the points at issue. Sometimes, it is true, errors of judgment are committed in the selection of the members of committees, an inconvenient number of members persisting in kicking over the official traces, but the suppression of the evidence and report meets such cases. The evidence and report of the Iron Plate Committee is one of the latest cases of the kind, the Blue-book, although for some months past in privileged circulation, not being likely to appear in the usual manner, unless insisted on by Parliament. The Iron Plate Committee was of faulty composition, possessing too many members with crotchets of their own, and too

few willing to be bought over by the illusion of prospective benefit.

The Necessary Consequence.

The necessary consequence of the mode of appointment will occur to most people after a moment's thought. As long as men are sought as tools for the performance of a public duty, the only reasonable expectation is that they will not be of the right sort. And experience bears out what may be conjectured *a priori*. It was true of the Iron Plate Committee, and is at present true of the Ordnance Select Committee, and the Armstrong and Whitworth Committee that they began their duties, prosecuted them, and, as far as they have been completed, completed them not in pursuance of any pre-arranged plan, and not by the light of pre-established principles. The rule of the committees has been the unusual and extraordinary one of at once seeking to frame principles, and simultaneously—in fact, in the same breath—giving judicial force to those principles which at the best could be only tentative. An analogous case would be that of a youth beginning to study medicine and surgery, and being instantly required to set limbs and prescribe. To put a series of cases—Mr. Brown's target is fired at, and although the committee's opinions about targets are crude generalisations, no sooner does the firing take place than Mr. Brown is, so to speak, put out of court by hasty dogmatism. Again—Mr. Jones's gun is tried, and although the committee's opinions about guns are crude generalisations, Mr. Jones's gun is declined. Last of all—Mr. Robinson's shot is tried, and although the committee's opinions about shot are crude generalisations, Mr. Robinson is never favoured with an order. The mode of appointing committees sets up as judges

those who are without the shadow of a pretence to be judges. Mr. Brown's target should be condemned on principles which Mr. Brown himself, if not wilfully blind, might assent to. Passing judgment on a target should be a deliberative straightforward act, because national interests are involved, and an off-hand judgment may eventually be reversed, after much waste of time and great outlay. So with Mr. Jones's gun. So with Mr. Robinson's shot. There should be no empiricism; if any, the Robinsons, the Joneses, and the Browns should be the empirics;—certainly not the judges, certainly not the committees. But the Shoeburyness committees, from first to last, have been pettifogging empirics—men who have neither satisfied themselves, the inventors, nor the public. Had they been practising medicine instead of gunnery, the well-known solicitor would have had them brought up at the Marlborough Police-court long ago. Science has been seldom scandalised by more impudent and unfit pretenders.

The Defence of the Committees.

But the committees have of course something to say for themselves. Let me give them a hearing. In the first place, they answer that they are adapting themselves to circumstances—to the very remarkable times in which we live. In other words, as nothing is known of targets, guns, and shot, but by experiment, they are without choice, and must elbow their way in the crowd of inventors and others. In other words, abstract speculation is worthless, and experiment must succeed experiment in the hope of the right thing being at last hit on. Men of education will perceive the fallacy involved in these assertions. As well may it be affirmed that the science of navigation should be discarded by the mariner, and that he ought to make for

his destination by experimental tacks at pleasure. It is safe to state that such a mariner would never reach his destination, and equally safe to state that a like method of investigation in gunnery is not soon likely to lead to practical results of any value. But lest this should be supposed to be fencing with the question, what is the scientific value of the facts which Captain Harrison, on behalf of the Iron Plate Committee, and Captain Heyman, on behalf of the Ordnance Select Committee, have been for years accumulating? This year the targets may not have been hit fair; therefore the guns are at fault. Last year the targets may have been fairly hit, but the plates have been penetrated; therefore the plates are at fault. The year before the targets may have been fairly hit, and the plates may not have been penetrated; therefore the shot are at fault. Surely an entire Blue-book of that sort of thing is not, in a scientific sense, worth the paper it is printed on. Where, then, is the justification of endless, unsystematic, unscientific experimenting? I affirm, without fear of contradiction, that the whole course of experimenting at Shoeburyness comes to this, and nothing more—that inferior armour-plates do not stand so well as good armour-plates; that small charges of powder do not perform the work of large charges, and that bad shot are of no use whatever. A dozen years of additional experimenting of the same kind would tell precisely the same story.

In the second place, I shall be told that the most eminent men of science have served on the Shoeburyness committees, and therefore that it is presumption to call their acts in question. This is a point of some delicacy, and only to be got over by the plainest speaking. Eminence in science—in the case, for example, of Mr. Fair-

bairn, a gentleman for whom I have great respect—means success in the manufacture of machinery; nothing more, nothing less. The case of Mr. Fairbairn differs from many others in this—that he has succeeded, and they have failed. Eminence has therefore no more to do with science than science with eminence; and they who worship Mr. Fairbairn merely worship his business profits. But for the sake of convenience and brevity, to rest the question on the case of Mr. Fairbairn, I have only to visit the public establishments of the country to learn that Mr. Fairbairn has a great customer in the person of John Bull. The mechanical appliances which Mr. Fairbairn is in the habit of manufacturing for private individuals he is in the habit of also manufacturing for the British Government. Mr. Fairbairn may therefore be regarded as the nominee of the Government of the day, when serving on any Shoburness committee. However eminent he may be in science, he is in the enjoyment of so considerable a portion of the public custom that the less said of him, and such as him, as authorities, the better. Then, to take another man of science—a man not of practical but of abstract science—a man for whom I entertain the greatest possible respect—Professor Pole, of King's College. Professor Pole, chiefly if not altogether because of his attainments in mathematics and his genial manner, was received into the official circle an unknown man. Without rendering any other service, without any other opportunity for distinction than that afforded by official drudgery in mathematics, he in his way has become as eminent in science as Mr. Fairbairn. Professor Pole's eminence is, however, different in kind from that of Mr. Fairbairn: the eminence of the latter, as before observed, being that of business success, while the

eminence of the former is that of having attracted official notice. As there are really no men eminent in science and connected with the Shoeburyness committees whom either Professor Pole or Mr. Fairbairn does not represent, it is mere artifice for the authorities to screen themselves behind those whom they have not only put forward, but in a certain sense have made.*

In the third place, the good opinion of the committees entertained by some inventors and others may be adduced. If so, the character is a suspicious one. Noticing how the official wind blows at Shoeburyness, I have found that there are men who will take slights and oversights in good part from great people, and who would be pleased to wait at the Secretaries' or the President's table,—perhaps to clean their boots. Nay more; I have found that there is the utmost unwillingness on the part of those with War-office or Admiralty expectations to risk compromising themselves by word or deed; as if conscious that the adoption of anything in the service is less dependent on the goodness of the thing than on the behaviour of the inventor, or of those who bring the invention to the notice of the authorities. To adduce the good opinion of inventors and others is therefore a strange proceeding. But lest I should be supposed to speak at random on this point, let me assure the reader that I speak both from observation and experience. The experience consists of direct communication with almost all the inventors who have figured at Shoeburyness, for

* The case of Mr. E. J. Reed is of the same kind. Before his adoption and sanctification by the Admiralty, he was nobody: now, to use an Americanism, he is some pumpkins. I say this not to disparage Mr. Reed, but in further illustration of the point at issue. The *one* good thing that the Duke of Somerset has done is the appointment of Mr. Reed. Were he to sweep out the whole Admiralty establishment from Admiral Robinson downwards, and appoint a dozen Mr. Reeds, he would do a *second* good thing.

the purpose of getting out of them what I could; and it has been a source of amusement to me to watch the development of the same weaknesses of human nature in persons as constitutionally unlike as night from day. One of the most cruelly treated Shoeburyness inventors received my proposition of accepting a full statement of his case with great joy, and insisted on me naming a day on which I should call and dine. My engagements would not admit of an acceptance of his hospitality, and I at once said so. He was then to prepare his case, but in the end his time was so fully occupied that he could not send a single line. The truth was, that he preferred keeping quiet to risk speaking out, and being thereby for ever ostracised by the powers that be. That case is only one of several; several, too, in the utmost need of ventilation. Again; the truth is, that inventors, as a class, hope on against hope, and it being the chief object of their lives to secure appreciation, they are as wise and guarded, and scarcely more adventurous, than middle-aged unmarried ladies.

The Committees a Bad
•Lot.

On the whole, then, the committees are a bad lot, moving in official grooves and circles, discouraging instead of fostering science and scientific genius, and exposing the country to the serious perils of disarmament without in the least sparing its hard-earned substance. As the committees are constituted, it would be preferable to dispense with them, and commit ourselves to the despotism of Pall-mall and Whitehall, because in that case ministers would be compelled to accept the responsibility of their position, and in so doing they would perhaps not err greatly. I say this with extreme reluctance, because from first to last the committees, on the whole, have treated me with

great indulgence. To the Ordnance Select Committee, especially, I am under great obligations, and I will do that committee the justice to state that the members are perhaps as unexceptionable as any can be under the present system. The system, however, being bad, the Ordnance Select Committee must share in the censure of the others. Indeed, during the early stage of the 7-inch gun competition, I believe that the Ordnance Select Committee furnished me for publication with inaccurate results as between the Lancaster and the Scott rifling—results, I believe, not accidentally but systematically erroneous in every figure. Captain Heyman, acting under the general orders of the committee to supply me with information, furnished me with *average results*, which I fancy I saw belied on the range, and which, after publication, were represented to me as the cleverest got-up averages that ever had appeared. The average results of Captain Heyman I therefore discontinued publishing; and in doing so I represented the case to the editor. At the same time I made repeated applications to the committee for access to the range-tables—the fountain of accurate information—and I at length succeeded. On the occasion of the first publication of the range tables, I stated that imputations had been made on the good faith of the Ordnance Select Committee, and that the publication of the range-tables was all the vindication required by the committee. There the matter rested, with this exception, that letters were afterwards written to the newspapers in support of the Scott rifling, the arguments resting on the erroneous averages which I had received and published. Those who wrote the letters will now, of course, modify their first impressions in accordance with the facts.

The True Principle of
Appointment.

The true principle of committee appointment, and the one which ought hereafter to be adopted, is that something specific is to be ascertained, and in a given time. It should be with Shoeburyness experiments as it is with jury trials at Guildhall and Westminster—a jury, the members of which may be challenged, should be empanelled for each cause. The Secretary of State for War, or the First Lord of the Admiralty, should direct that a certain trial should take place on a certain day, and that the finding of the judges should be immediately reported in Pall-mall or Whitehall. That is not only the fair way as between man and man, and between individuals and the Government, but it is the only possible means of hitting the right nail on the head. I am justified in stating, not merely as the result of personal observation and reflection, but as the opinion of some distinguished officers, that no problem, be it of targets, of guns, or of projectiles, was ever yet, or ever will be, offered for solution at Shoeburyness which does not admit of absolute and final determination in the course of a single week. I may add that, in season and out of season, I have represented this to the members of the committee and to the inventors; and I am much mistaken if Sir William Armstrong's partners have not assented to the truth of the appeal. Talking quite recently, and for the first time, with Mr. Lancaster on the same subject, he frankly admitted that a week would suffice for the complete trial of his gun, and for the complete trial of any gun.* I tried

* It will, as a matter of prudence, be well for me to fortify an opinion so much at variance with general Army and Navy notions by an appeal to John Stuart Mill. He says, page 350, 5th Edition, of his *Logic*:—

“Why is a single instance, in some cases, sufficient for a complete induction, while in others, myriads of concurring instances without a single exception, known or presumed, go such a very little way towards establishing an universal proposition? Whoever can

hard to get him to say that a single day would suffice. Such being the case, the question of the committees is at once simplified. No Shoeburyness committee should be appointed for a longer term than a week, and the same men should not, if possible, be called upon to sit on two trials. The abominable practice of making a trade of committees must at all events be abandoned. If those who have long served as Shoeburyness committeemen are of opinion that they have served sufficiently long to have acquired a vested interest in experiments, like the City Liverymen in the privileges of the Corporation, let them be met in a spirit of liberality and got rid of. Let them, rather than remain as they are, become new charges on the Pension List or on the Consolidated Fund.

answer this question knows more of the philosophy of logic than the wisest of the ancients, and has solved the problem of induction."

Such is John Stuart Mill's testimony. My own is, that a gun *once* fired will then and there show what it can and cannot do, and that the conditions of firing admit of very trifling variation.

At the early Armstrong and Whitworth trials Mr. Whitworth frequently complained to me of the few rounds allowed to the guns at the various elevations. I am inclined to blame Mr. Whitworth for the propagation of the philosophical error of supposing that his guns and other guns must be fired for a twelvemonth or more before an opinion on their qualities can be expressed, and that even then much will still remain undetermined. The weak-minded officials who have served on the committees have generally adopted Mr. Whitworth's view, and so, I fear, has Lord De Grey.

CHAPTER IV.

THE INVENTORS.

Early Impressions of
Them.

My early impressions of the Shoe-buryness inventors may be summed up in very few words. I never found them at a loss to account for every mishap. I have always found them trying to gain their ends by hook and crook. I have always found it prudent to disbelieve them in nearly all they said. These may appear harsh judgments: they nevertheless are not, and if ever lying is justifiable, unscrupulousness a virtue, and ingenuous the claiming or disclaiming for an invention as suits the purpose, it is in the war which inventors at Shoe-buryness are required to wage. Inventors appearing at Shoeburyness must resort to analogous artifices to those employed by a force gaining a footing in an enemy's country, otherwise they will be ruthlessly trampled under foot.

The Three Courses before
Them.

There are three courses before an inventor who has anything relating to guns to try. He may in silence perfect what he has in hand, and some morning bring out the invention in the newspapers. Mr. James Mackay, of Liver-

pool, took that course with his gun, spent upwards of 6,000*l.*, and astonished everybody. Of his gun the world knew nothing until after the firing on Crosby Sands, and then it is understood Mr. Mackay approached Lord De Grey, hat in hand, for the first time. Mr. Mackay may be conceived as saying that he, a Liverpool merchant of position, finding that the service stood in need of a good gun, had given his attention to the subject, and produced what he thought was wanted. Lord De Grey, on the other hand, may be conceived as merely shrugging his shoulders; because the Mackay gun does not appear to have been more favourably regarded than if it had been produced at Woolwich for the public on behalf of any one with talking influential friends who happened to be out at elbows. The Mackay proceeding may be named the high polite, or business one—calling at the War-office in true commercial style with a sample of the commodity. That apparently it has not met with appreciation is for various reasons a matter of regret. The War-office should have hailed with satisfaction an innovation the tendency of which is to relieve the Department from a heavy charge. It is, besides, an encouraging sign for a merchant to give a portion of his time to guns—a step, moreover, in the right direction, when for once the improvement of guns is disassociated from the haze of learning, so called, with which it usually is surrounded. Really, Lord De Grey would not have been going out of his way had he accompanied Mr. Mackay to Shoeburyness, and on the spot instructed the Commandant to further his views to the greatest extent possible. In another place the Mackay gun will be found spoken of.

The second course is to approach the War-office in *forma pauperis*, as the great body of inventors have

done. Probably the greatest sinners in that way, the Armstrong Company not excepted, have been the Manchester Ordnance Company, represented by Mr. Whitworth. The Manchester Ordnance Company, apart from the £22,000 or so of experimental money paid to Mr. Whitworth, before, I believe, the Manchester Ordnance Company was promoted by Mr. Whitworth, have cost the Exchequer in superfluous, if not useless guns, in ammunition for those guns, and for Laboratory and Shoeburyness ammunition experiments for those guns, conducted by Colonel Boxer, a sum of money sufficient to provide dowries for the unmarried members of the royal family, or to construct nearly all the refuge harbours needed for shipping on the east coast of England. Colonel Boxer has long had *carte blanche* from the War-office for Whitworth ammunition and projectiles, and they who know the gallant officer need not be told that his praiseworthy zeal could not be exceeded were he *de facto* the chairman of the Manchester Ordnance Company. I challenge the Manchester Ordnance Company to show that a shilling less than £250,000 of the public money has been squandered between the invention of the Whitworth guns by Mr. Whitworth and the inventions of Whitworth shell, cartridges, fuzes, lubricators, &c., by Colonel Boxer. Approaching the War-office in *forma pauperis* is a proceeding of great risk until a thoroughly good official footing is obtained. A favourite course appears to be the getting of Director of Ordnance orders to witness the Shoeburyness experiments, and to make the most of the opportunities in holding umbrellas, helping on great-coats, calling coachmen, and showing round specimens of the shot, armour, and backing to the great men present. Zeal in those ways is, sooner or later, sure to be rewarded by

smiles, open ears, promises, confidences, and so on, and eventually the inventor may feel his way towards writing letters to the minister. In time he may even get up a grievance, send round pamphlets, and command the patronage of one or two members of the House. Another plan is to get the names of the messengers of the War-office, and after feeling among them for a month or two with cigars, beer, or gin, to take a house or lodging near the one or two most likely to serve the inventor's purpose. A warm confidential friendship is then promoted, and, two heads being wiser than one, something is sure to come of it. The ear of some one of consequence is gained in some way or other, whether by flattery, pledges, or notes of hand is immaterial, and afterwards the ball is opened. An inventor approaching in *forma pauperis* without breaking the ice is, as a rule, brought up in much the same manner as a costermonger would be who sought a presentation at Court from the Lord Chamberlain. A frigidly formal printed note—printed on purpose for those who do not know the ropes or do not care to pull them—disposes of him.

The third course, now followed religiously, I am told, by the Blakely Ordnance Company, is not to know the War-office or the Admiralty, but to feel oneself resident in Japan or China. If not the most patriotic it is the most dignified. It is taking your horse to market instead of coaxing the doctor or the parson to become a purchaser. It is obedience to one of the great laws of commerce—the one which enunciates the impolicy of seeking anything but an open field and no favour. The open field before the inventor are the armies and the navies of other countries, which have the same motive as our own army and navy to accept the good things offered to them. And it must be confessed that foreign

governments are easier served by Englishmen than the British government by Englishmen. Just now there is hardly an European government out of the English market for the engines of destruction ; and there are few of the great manufacturers without foreign warlike orders. Perhaps when the Blakely Ordnance Company have armed Cronstadt Lord De Grey will invite the members of the firm to an audience and a luncheon.

One Great Discouragement.

One great discouragement to the inventors is the official disposition to foster genius among officers, as if genius admitted of the same propagation as slips from window-pots or green-houses. Officially it is felt to be little other than degrading for the service—indeed, for the navy as well as for the army—to depend on civilians for improvements or inventions of any kind, and, accordingly, while the cold shoulder is given to the great body of the inventors, a handful of army and navy parasites may try anything they like and as often as they like. They have only to take the president of a committee by the button-hole, or make an eleven o'clock call at Whitehall or Pall-mall, and the thing is done. Without calling those of whom I speak by an offensive name, it will be refreshing to the great body of the inventors to be told that one of the professional competitors in one of the recent gun competitions has, I believe, had the resources of the Royal Arsenal as much at his disposal as if the establishment were his own ; ordering this, considering that, and repairing such blunders as the one of placing the bearings of his shell on the loading instead of on the bearing side. Because the gallant officer is a professional the official teat is extended to him. Because the gallant officer is supposed to use guns, it is assumed that he knows a great deal

about them,—a method of reasoning identical with that of assuming that those who drink stout, or partake of the compound known as milk, are aware what they are really taking. Could the official logic hold water, the Piccadilly swell would be a shoemaker by virtue of his boots, and a washerwoman by reason of his pocket cambric. Among the military there are not a few as highly favoured as Commander Scott, and with no better claim to be highly favoured than Commander Scott. I believe Major Pallisser, the improver of cast-iron guns, and also the inventor of the milk-and-water process of chilling cast-iron shot, is almost as greatly privileged as Colonel Boxer. The Major, I am told, may go to Shoeburyness at any time, and, in the presence of small circles of private friends, employ at will the public gunpowder against the public targets.* Several subaltern officers, Lieutenant Reeves among the rest, I have seen conducting experiments of their own, on the principle, I suppose, of the ox not being muzzled which treads out the corn. Then, who has not heard of the costly targets of Captain Inglis—Captain Inglis the Shoeburyness officer of works. And Army and Navy officers thus encouraged have up to the present time failed to justify the foster-

* On one of those occasions I was present, and the three shot fired for the edification of those assembled went to smash, doing no injury whatever, and thereby establishing the fact of the unreliability of the chilling process. I was sorry for the Major, and sent in no report of the experiment, and the next time I met him he thanked me for the omission. So well he might, as a report of the failure would have taken the gilt from the persistent and unblushing puffing that the chilling process had previously and has since received. The chilled shot will never, I trust, be adopted by the War-office, because, if it ever is, the duty of exposing its worthlessness will be imposed upon myself and others.

While condemning the chilled shot I may take this opportunity of recording my approval of the gun-lining of Major Palliser. It is, as far as it goes, unexceptionable, and a large number of 68-pounders ought, if needed, to undergo conversion. But at the same time it is worthy of consideration whether the stock of 110-pounders is not already in excess of all the probable wants for such calibres as Major Palliser proposes to supply.

ing bestowed on them for displays of genius. Green tea might as well be cultivated on Hampstead Heath, or genteel lodgings hired in Seven Dials. Less ingenuity and less originality have been displayed by all our Army and Navy officers put together than is to be seen in one of the *seances* of the Davenport Brothers. Commander Scott has made the best return of any officer, he having, in occasional lectures at Charlton and elsewhere, praised and censured by turns one and all of the civilian inventions of the time. Rather oddly, after rating everybody, his own inventions are not worth praising. The Admiralty should reward an officer of so much zeal by putting him in the way of obtaining his promotion before the Order in Council renders it too late.

The Justification of the
Inventors.

The inventors having thus to wage perpetual and harassing war against their enemies need not be particular about the weapons. The contest is with the knife and to the knife. If chicken-hearted, the printed bullets of the War-office will pepper them. If indomitable, they will at least receive the soft-soap attentions of the committee with whom they have to deal. I have often watched the small attentions of the committees—so often that I have set it down as a settled thing that when an inventor is made much of it is intended to let him down gently. Of course, the inventors here spoken of are not the officially favoured ones who dine the committees and receive the dinners of the committees, but the struggling. Nothing short of an earthquake appears likely to rid the public of such corporations as the Newcastle firm of Sir William Armstrong or the Manchester Ordnance Company of Mr. Whitworth. The struggling inventor is perhaps best represented by Mr. James Chalmers, the inventor

of a target the principle of which was appropriated by the Admiralty not merely without acknowledgment, but with an attempt to prove the invention their own property. Mr. Chalmers fought the Admiralty, and with this extraordinary result—that the War-office paid his claim against the Admiralty, and when doing so gave him a new order for a fortification shield. When hereafter an inventor is in a tight place, officially, let him take courage from the success which has attended the outspoken protest of Mr. Chalmers. Had Mr. Chalmers been ill instead of well advised, he would have lost the money righteously belonging to him, as well as his present order.

The Inconvenience of
Contention.

The inconvenience of contention between the inventors and officials is pretty well known. The War-office and the Admiralty attempting to stir, may well remark—

When I shun Scylla, your father,
I fall into Charybdis, your mother.

Right and left, in front and rear, both Departments are in the meshes of the Patent law, as powerless as a Guildhall turtle in one of Pickford's carts. The Armstrong Company have their patents, and the Manchester Ordnance Company have their patents, one and all of which I believe ought to be public property. Mr. Whitworth's results were for the public—certainly not for himself and the Manchester Ordnance Company. So in the case of Sir William Armstrong and the Armstrong Company—the results which Sir William Armstrong was paid to work out are the property of the public, certainly not the property of himself and the Armstrong Company. The Armstrong and Whitworth patents are in the rear of the War-office and the

Admiralty, because they are stupendous monuments of extravagance and folly. Any retail tradesman would have concluded a better bargain with Sir William Armstrong and Mr. Whitworth than the authorities have done. The authorities, when urged to do something towards the armament of the two services, look back, like Lot's wife, and perhaps for the same reason. To the right and left of the authorities are ranged those whose patents have been more or less considered, and who have secured to themselves as inventors every contrivance, adaptation, change, alteration—in short, every possibility and as many impossibilities as up to the present time they can think of. Neither to the right nor left, therefore, may the Secretary of State for War or the First Lord of the Admiralty direct their gaze, unless prepared to put their hands deeply into the Exchequer. The enemy have hemmed them in—rendered them completely powerless for good or evil without paying. In front of the authorities are the James Mackay men—the new and untried ones who properly as Englishmen consider themselves as well entitled to consideration as Sir William Armstrong and Mr. Whitworth.

This is an extraordinary state of things, and most unhopeful. It is deadlock. It is a signal defeat—the well-deserved fate of official chicane. Nothing but the hypothesis of a softening of the brain can account for the official assumption that the restless men who invent may be put down as easily as Army and Navy officers—by the opinions of my Lord or of my Lords. Inventors are without the least reverence for the one or the other, and I have frequently heard some of the illused ones say that they would like “to take it out of the skin” of Lord De Grey or the Duke of Somerset. Nor is this

remarkable, for while officers have a great deal to hope for in the way of fancy appointments from standing well in high places, inventors have no expectations beyond their inventions. On one occasion, I remember, after stating in one of my reports what I believed to be the truth about one of the 7-inch guns, the interested professional inventor took an early opportunity of threatening me. I was at the door of the Royal Hotel, Southend, waiting some information from the Ordnance Select Committee, when the gallant officer came in sight with his hands in the back pockets of his brown paletot. He said he had the *Times*, the *Telegraph*, and several other newspapers at his command, that he could give hard knocks, and that I had better be on my guard in future. My knees, of course, trembled, my heart fluttered, and my pale face reddened, until I suddenly remembered that on one occasion, when at the mess at Shoeburyness, Mr. Stuart Rendel, addressing me, conveyed across the table an insult to the officer in question, which was neither noticed nor resented. Taking courage from that recollection, I merely invited him to use his influence without delay. He was the first and only inventor that ever threatened me—the only Shoeburyness inventor, with one exception, I have ever known who desired to promote his cause unfairly.

A Case of Bribery and Corruption.

The other case was one of bribery and corruption. It happened in this manner. I was one day in the slaughter-house with a crowd, waiting some very slow firing at a Warrior target. Suddenly I received a pull on the arm, and, turning round, a well-known face confronted me. Hand-shaking followed, and a whisper in the ear invited me outside. I expected to be put in possession of some

facts in relation to the trial then in progress, and willingly assented. We passed out at the minor archway, and as soon as we were beyond ear-shot of those inside, profuse thanks were tendered for the service I had rendered the party in one of my books and in the newspaper. Simultaneously with the verbal outpouring, my left hand was laid hold of, and a sovereign pressed into it. I protested, insisted that he was mistaken, and so on. It was a very trying moment: one of the most trying of my life. My first impression was that I had become the victim of a conspiracy, as no doubt, for want of anything better to look at, those inside the slaughter-house—Mr. E. J. Reed, the Chief Constructor of the Navy, and other Admiralty officers, were among the number—had witnessed what had taken place. Mentally cursing the party for the embarrassment he had occasioned me, I withdrew to the mess-room, while he again sought the shelter of the slaughter-house.

It is, I think, very creditable to the great body of the inventors with whom I have come in contact, that the case of the gallant officer stands alone for intimidation, and the case of the sovereign stands alone in respect to bribery. It is unnecessary to pain the offender with the sovereign by the publication of his name. He is a very estimable man, with a very humble opinion of the press and the members of the press. Perhaps by this time his views are more elevated. He and all ought to know that members of the press—at least, those in a position to be sent to Shoeburyness to report on a long course of experiments, to which the attention not merely of the country but the world is directed—are quite able to do without his sovereign. They are in the receipt of an income sufficient for all their moderate wants, and few of them have an inordinate desire for money.

Why bribery is so exceptional in the case of the inventors may be explained by the confidence of each inventor in the goodness of his cause. Each goes to Shoeburyness impressed with the belief that if fair play is extended to him failure is impossible. Invariably each accounts for his mishaps in a perfectly satisfactory manner, and therefore feels it to be unnecessary to resort to irregular and improper means. What, however, all overlook is, that when the conditions of trial are greatly varied—when the theory of an invention is proved erroneous without modifications, those modifications may practically destroy the pretensions of the inventor; so that, strictly speaking, he should confess his failure and withdraw. But of course, as Sir William Armstrong and Mr. Whitworth have been permitted to cobble their theories, the principle of cobbling theories cannot fairly be departed from with others.

Waywardness of the Inventors.

That the inventors are sometimes wayward is just saying that they are like other people. An amusing instance occurred in my experience, which may be mentioned as to some extent characteristic of one of the number, if not of all. At the commencement of the Armstrong and Whitworth competition I, in common with most people, had a strong Whitworth leaning. I thought that we had done too much for Sir William Armstrong and too little for Mr. Whitworth. There was no reason why I should refrain from saying so to Mr. Whitworth, because I had said so in my reports, which then appeared daily, and which were handed about on the range by readers of the newspaper. I saw the comparative disadvantages under which Mr. Whitworth laboured—comparative in the sense that,

while Mr. Whitworth appeared to know next to nothing about guns, Sir William Armstrong appeared to know more about them than any one at Shoeburyness; and comparative in the sense that while the Whitworth gun was a strange weapon to the gunners, the Armstrong gun was the familiar weapon which they used at drill—and I frankly pointed out the disadvantages to him. Mr. Whitworth was greatly pleased with me, and stands indebted to me for various hints which he acted on. I, however, never forced myself on Mr. Whitworth, and neither drank his wine nor ate his dinners; and it may be well to add that from Sir William Armstrong I have stood equally aloof. The competitive trial proceeded, and with its progress the inexorable logic of facts led me to render justice to Sir William Armstrong. Mr. Whitworth did not like the change. He became altered. He kept apart, remained silent, and eventually passed me without recognition. He who was not for Mr. Whitworth was against him; and Mr. Whitworth does not conceal his feelings. Among some friends I jested about the change in Mr. Whitworth, and one day I cruelly bet a hat that I would make him speak to me. The bet was taken, and we followed Mr. Whitworth to the mess-room. I sat down opposite Mr. Whitworth, and the topic of conversation being the American news, I suddenly broke in, looking Mr. Whitworth full in the face, and asked whether it was true that some of the batteries of 12-pounder Whitworth field guns supplied to the Confederates had been delivered without shell or fuzes. There was only a moment's hesitation; Mr. Whitworth replied with his usual suavity. I have not troubled him since, and all my subsequent intercourse with the Company represented by Mr. Whitworth has been with his business partners, Viscount Torrington

and Mr. Aston, the barrister. To do Viscount Torrington and Mr. Aston justice, they have been wiser than Mr. Whitworth; frank and courteous always.

Their Great Grievance. The great grievance of the inventors—the one that comes next to the non-adoption of their inventions—is the compulsory confidence they are required to place in those in whom they have no confidence. Up to a recent period any one might approach the battery from which the experimental guns were fired; but under the paltry pretence of danger the privilege has been greatly abridged, if not absolutely withdrawn. As long as the privilege was accorded, the inventors, if cheated, were cheated respectably. They received a short weight quartern over the counter, on the faith of its being a full weight one. Now it is compulsory to take what is assigned them. They have not the satisfaction of knowing that eggs are eggs. Colonel Wilmot, the Commandant at Shoeburyness, may, for example, order twelve-pound charges for the guns, and the officer in charge of the firing may state that the charges are sixteen pounds. Among the inventors, the possibility of fraud is not what troubles them, nor even the probability, but it is the conviction that they are tricked, and tricked systematically. My own impression is, that they are not far wrong. Before I knew anything of the Secret Ordnance Committee, I thought, from personal observation, that in the matter of weights there was a screw loose. After knowing of the Secret Committee, and seeing one of their reports, there remained no room for doubt. The Secret Committee work the Shoeburyness oracle.* They can demonstrate

* The members of the Secret Committee are also members of the other committees. Their reports are occasionally to be picked up in the second-hand Blue-book shops,

any effect they please, beating those who ought not to be beaten, and making those winners who ought to be several lengths behind. The official justification of the Secret Committee is, that so great publicity is given to everything, and that it is desirable for the authorities to keep something to themselves. Unfortunately for the official justification, the Secret Committee was in existence before publicity was given to the Shoeburyness experiments. The truth is, that the want of a secret committee was early felt, as the only means of fencing efficiently with inconvenient questions put in Parliament.

among the Blue-books sent in for sale by the servants of officials. Secret committees have also sometimes gone abroad, and their reports are to be collected in the same manner. Secresy does not thrive in England: so badly, indeed, does it thrive that a few pounds will always purchase the most carefully guarded secrets of the Woolwich or the Pall-Mall prison-house—whether the results of trial or the drawings of guns and projectiles.

Were I a Shoeburyness inventor, I would always stipulate for the weighing of the shot and the charges in my own scales, with my own weights, and endeavour to be allowed to take to pieces one of the charges which were to be fired.

CHAPTER V.

THE PUBLIC.

The Awakening.

The public were slow in taking an interest in the Shoeburyness experiments, and no sooner were the supposed points and tendencies mastered than the interest slackened and abated. Few now care to see, much less peruse, a Shoeburyness report, especially an Armstrong and Whitworth competitive one; and when the Armstrong and Whitworth Committee report—if ever they do report—their labour is neither likely to excite enthusiasm nor applause. So it is with all sensations. They have no resurrection. When the public mind was at the utmost tension there was a curious feeling brought out by my reports. It was the old-fashioned one of military power as distinguished from civil power; as if the latter were in subordination to the former. The question then in course of solution was whether the shell of the Armstrong or those of the Whitworth were the more destructive, and it was determined by placing dummy gunners at their stations behind the parapet of one of the Shoeburyness field works. In reporting the effects it was said that so many gunners were killed or disabled at each of the three guns; and the statements were accepted as literally true. London was not exactly shocked: it was, as the

Americans say, exercised ; it sentimentally regretted the sacrifice of the wood soldiers to the inexorable demands of duty and the national love of fair play. So public opinion would appear to sanction the killing and wounding of soldiers in experiments ; and shortly afterwards the Armstrong and Whitworth Committee in consequence of that accidental gauging of opinion, were prepared to sacrifice life in the first rapid firing of the guns. Fortunately none of the guns burst, and the question, therefore, was not raised whether a military committee are amenable to the civil law when, with their eyes open, they sacrifice life and limb. I was informed of the probability of a serious loss of life during the rapid fire, and arranged for the immediate transmission of the horrors for the afternoon edition. A more intelligent and spirited condemnation of the supposed killing and wounding would doubtless have prevented the revival of what may surely be regarded as an obsolete power. But the imaginary wrongs of Mr. Whitworth warped men's judgment for the time. They were prepared to go any length and make any sacrifice until the inevitable reaction set in, with fuller information.

**Mysterious Nature of the
First Reports.**

The earliest reports appeared, with rare exceptions, in the *Times* exclusively, and were understood to emanate from junior officers of Engineers. The exceptional and oracular furnished brief summaries of what had been done, what was in contemplation, and what was occurring elsewhere. Occasionally the reports were prophetic. When neither prophetic nor instructive they were mysterious. The authorities had hit on an asphyxiating compound which, when liberated in gas from hollow shot, would

kill those who sniffed it; a shell so strong as to lodge in anything, and yet so fragile that on concussion it would separate into deadly fragments; a target which would absorb impact on its whole, or on half its surface; a gun which would do everything but shoot round corners or pay the Christmas bills of tradesmen. The wildest conjectures were hazarded, and the most bare-faced contradictions passed unchallenged. Public opinion was then unformed; and therefore in the main it was unconcerned.

Difficulties in the Way of
the Later Reports.

As the press is indifferent to unpopular topics, the *Times* was for a time suffered to enjoy the monopoly which it had acquired. But animated debates in Parliament and angry correspondence in the newspapers and in pamphlets bringing Shoeburyness within the round of daily subjects, information came to be needed and supplied. It was my good or evil fortune to be deputed to break through the exclusiveness of restricting visits to the uncertain because arbitrary delivery of tickets, on the occasions when tickets were distributed. I went in the first instance to the Committee on Iron Plates in Victoria-street, from there to the Committee on Defence, from there to the War-office, and from the War-office to the Admiralty. The Admiralty had nothing to do with the experiments: the Iron Plate Committee were the proper parties. Neither the Admiralty nor the Iron Plate Committee had to do with the experiments: the War-office was the proper quarter, and the proper War-office officer was to be found at the Defence Committee. At the Defence Committee no one knew anything about the War-office or the experiments. What was to be done? I had been moving in a circle for weeks; officially baffled at

every point. One day it happened that I was at Shoe-buryness in the regulation manner, and travelled back to town with Mr. Stansfeld, then newly appointed Civil Lord of the Admiralty. I represented the hard case of the public paying for the experiments without the press being on a privileged footing; the press only knowing by accident when firing was to take place, and depending on private persons for their cards of invitation. Mr. Stansfeld thought the press had a right to be present on all occasions; precisely the same right as that possessed in the galleries in Parliament. He promised to help me through the difficulty. Some weeks more passed in fruitless representations and discussions with Major Freeth and Major Dyer at the War-office, and with Captain Harrison at the Iron Plate Committee. One day, towards the close of the session, I made my way to the Admiralty to ascertain what Mr. Stansfeld had accomplished. Mr. Stansfeld was hastening to the House to make a house, and Lord Clarence Paget joined him. Mr. Stansfeld introduced me, and I shortly urged the case of the public and the press. His lordship referred me to the Iron Plate Committee and the Defence Committee, but fortunately I had already squared the circle. He then admitted that the Admiralty had the power, that he was the proper party to apply to, but that he had never exercised the power for the press—not even for the *Times*. Understanding at the time that the *Times* had *carte blanche*, I pressed him closely on the point, and he said that if the *Times* were represented, it was without his permission and in an irregular manner.* He then requested me to send a formal

* I subsequently learned that from first to last the *Times* has been on exactly the same footing as the other morning papers, which obviously is as it should be, the *Standard* and the *Telegraph* having each not less than four times the daily circulation of the *Times*, and each probably eight times as many readers.

application to the Admiralty, and it would be considered and replied to.

After all, the Admiralty had no power even in the case of their own target experiments, the War-office turning out to be the sole authority. Patience and diligence were at length rewarded, and on the 1st April, 1864, monthly tickets were, I believe, issued to all the London morning papers applying for them.

The Working of the
Privilege.

From April till the autumn holidays the privilege worked admirably. Shoeburyness might be gone to at all times without formality, and all the experiments which took place might be watched, reported, and commented on. Nay more, the Commandant, General Taylor, was exceedingly courteous to the press, and the subordinate officers, following the example of their chief, were likewise all that could be wished. About Shoeburyness there was no place that the press might not visit, and no question that they might not ask. In a word, from April till the autumn holidays the press were under no restriction.

With the autumn, when most of the officers received their holidays, came a change. General Taylor was removed on promotion, and an officer who had served under General Taylor with general satisfaction to those who had previously been visitors, reappeared with the new Commandant, Colonel Wilmot. That officer was Captain Alderson. He had been sent with Colonel Galloway and others to investigate artillery matters in the United States, and was now to resume his post as superintendent of the experiments. I shall speak of his treatment of myself, and leave Captain Forbes of the *Telegraph* to tell his own story, as no doubt he some day will, and the representative of the *Times* to tell his

story, as no doubt he has one also. Captain Forbes nor the representative of the *Times* has since attended a single experiment from the occurrence of the insults to the time of this present writing—10th February, 1865. I had found my way to Shoeburyness one forenoon during the autumn holidays to see if there were anything going on, or to find out when there would be anything going on. There was nothing doing, and I sauntered towards the mess-room and partook of a beef-steak and a glass of ale.* Remembering that I was desirous of getting access to the papers of the Corps of Engineers to find out—for this book—what Captain Inglis had said of the experiments, that Captain Inglis had previously referred me to Woolwich for those books, and that at Woolwich I had been referred to the keeper of the Shoeburyness library, I called Sergeant Cox and told him my wish, narrating the circumstance of speaking to Captain Inglis, being sent to Woolwich, and from Woolwich to the Shoeburyness library. Sergeant Cox at once withdrew to the library, brought me the books, and at my request placed them on a side table. To the side table I went so as to be out of the way of every one, and began to take notes. While so engaged Captain Alderson passed the open window, and, seeing me, he turned, entered the mess-room, and followed Sergeant Cox to the kitchen. In a few minutes he emerged from the kitchen, and, with one of my monthly cards in his

* Steaks and ale were provided at the public charge, because there is no hotel at Shoeburyness. For each meal the mess charged the public, I believe, two shillings, and as the tickets giving the steaks and ale authority were monthly tickets, the mess made a good thing out of them, the average of the press dinners being fewer than four a month for each member. In other words, the press dinners averaged 8s. monthly, and I believe the mess charges were per month, whether or no the steaks and ale were had. I mention this as a proper matter for investigation, because it may turn out that the disallowance of the per-month claims for the press dinners by the Woolwich authorities had something to do with the proceedings eminently unbecoming officers and gentlemen to which the press were subjected.

hand, he stood before me, and, in a most offensive tone, asked to what he was indebted for my visit to Shoeburyness on that day. I told him, and explained about the books. Resuming the offensive, he told me that I was an intruder, that I had no right in the mess-room, nor in any other room, and that hereafter, on visiting Shoeburyness, I must report myself to him, and he would inform me whether I might remain or leave. The only justification he offered for this placing of the press under martial law was that the mess had complained of the presence of strangers, and that a vote had been passed for their exclusion. The other representatives of the press were, I believe, insulted in the same manner, either on the same day or within a day or two after.

But exclusion from the mess was not the bounds of the wrath of Captain Alderson. On that day ended all possibility of obtaining accurate information, members of the press being excluded from the batteries by an extensive rope fence, and prohibited from conversing with the officers in charge of the batteries. That exclusion and prohibition continue, and will continue until Captain Alderson and Colonel Wilmot have been removed from Shoeburyness to make way for officers of a different calibre. Their transportation beyond the seas cannot, for the interests of the press and the public, take place a single day too soon.

One word more. The batteries have remained open as before to the retainers of Sir William Armstrong and Mr. Whitworth, and those retainers enjoy their luncheon at the public charge at the mess as before. Until the press was placed under martial law by Captain Alderson and Colonel Wilmot, its members partook of luncheon on some occasions with the Duke of Cambridge, the Crown

Prince of Prussia, and other celebrities, Major Milman and other officers extending to them every courtesy. To the War-office I was represented as having used the mess-room as a home, going to the library, &c., and helping myself. The officer who made that representation is not a man of truth. I have never once been within the library, and I never was more than once within the mess-room in the course of a single day, and usually not more than fifteen minutes at a time.

On informing some of the young officers of what had taken place they assured me that no complaint had ever been made against the press in the mess-room—on the contrary, that their presence was always welcome, that no meeting of the mess had been held on the subject, and therefore that the proceedings were unauthorised by the mess. One officer, since promoted, thought the matter should be reported at headquarters, and the hospitality of the mess-room vindicated to the press.

The Shoeburyness privileges of the press are thus practically at an end. I have no desire to fight their battle over again with officials: others must do it, if done at all. Captain Forbes, of the *Telegraph*, I understand, addressed Lord De Grey on the subject without success, an apology for superfluous rudeness being resolutely withheld. It was too much even for the press to ask the censure of a Second Captain of Artillery—that, unless I make a mistake in the name, being Captain Alderson's position on the seniority list—a position financially inferior to that of a porter on the establishment of a morning paper.

Commercial Privileges.

While such are the hard lines of the press, the great official favourites enjoy useful privileges. One day, when the 12-pounder field Armstrong

and Whitworth guns were under trial, the military representative of one of the American belligerents drove down, I think, with Mr. Whitworth—Mr. Whitworth driving his one-thousand-guinea mare. The visit was for the purpose of deciding from actual observation which of the rival guns with its projectiles would destroy the greatest number of the enemy. My opinion was asked and given, and after an interesting day's firing, followed by the "flowing bowl" at the mess-room, the military representative drove to the Royal Hotel, Southend, and no doubt the same evening ordered the eight batteries of a full Field Artillery Brigade. Among the Shoeburyness officers there was a good deal of gossip over the occurrence, inasmuch as the choice of the military representative was held to be "neutral" testimony in favour of the service weapon. The circumstance, as well it might, reached Lord De Grey's ears, and I believe Sir William Armstrong was soundly rated by his lordship because Mr. Whitworth had not obtained the order. Thus Shoeburyness is prostituted to the commercial dealings of the great Ordnance companies—foreigners with orders in their pockets having the destructive effects of the great rival guns demonstrated before their eyes, while the representatives of the press, from the *Times* downwards, must stand at 100 yards' distance, outside of a rope fence, because it is assumed that they have no right to see or hear anything.

The Impossibility of Secrecy.

As long as it is permitted to official favourites to introduce their customers at Shoeburyness secrecy is obviously impossible, assuming that to be the ground of the press exclusion. Those customers are the very men from whom improvements, changes, or inventions ought to be withheld; and yet,

unless they are permitted to see and know everything, they cease to be customers because they cease to make purchases. They therefore find their way to Shoeburyness as a matter of course, and in the matter-of-fact fashion that a miller visits Mark-lane or a pepper dealer Mincing-lane. At Shoeburyness they institute theoretical and practical comparisons, and afterwards make their purchases in a perfectly satisfactory manner. Away their purchases go to the field or garrison, if the buyers are American, and to their own arsenals, if the guns are only bought as patterns.

Were this transforming of Shoeburyness into a foreign market for English inventions in ordnance to be restrained by peremptory order from Lord De Grey, the order would merely entail on foreigners a day or two of trouble. They would then have to go to the Elswick Works to see the Armstrong guns, to the Manchester Ordnance Company to see the Whitworth, to the Blakely Works to see the Blakely, and so on. A ten-pound note would almost meet the case, and it is a question whether the practice would not on the whole be more advantageous than that which obtains at present. General Todleben, for example, arrives in England, and is the guest of Captain Blakely. As the guest of Captain Blakely, General Todleben leaves Captain Blakely with all the information that the latter can supply, while during a mere run to and from Shoeburyness the one would be absorbed about selling and the other about buying. General Todleben the guest of Mr. Whitworth would, in like manner, worm out every secret worth knowing. So as the guest of Sir William Armstrong; so as the guest of any ordnance manufacturer. It is, in a word, the business of an ordnance manufacturer to be up in everything that relates to guns

and projectiles; and as a matter of fact it is the case that, although the works of one ordnance manufacturer are not visited by other manufacturers, each knows exactly what the others are about, and the prices at which they are working. All besides know what is doing and what is in contemplation at the gun factory. Generally the workmen shifting from shop to shop are the medium of communication; and between overseers and foremen there is this freemasonry, that those of one shop or of the Royal Arsenal can ask and procure anything from the other. Therefore, at any time any foreigner can command our secrets, whether Lord De Grey forbids or enjoins.

Captain Inglis's Papers. But the impossibility of secrecy is confessed by the publication of Captain Inglis's papers in the annual volumes of the Corps of Engineers. In those papers Captain Inglis has compiled a record of the experiments, and the papers are accessible to the British Museum readers. They may, indeed, be purchased from the publisher through any friendly officer—from Mr. William Parry Jackson, Woolwich.*

The Rights of the Public. Of the rights of the press and the public—especially in the presence of these facts—to all the experimental information that Shoeburyness can afford, no sane Englishman will doubt. The public pay for the experiments, and the public have infinitely less reason to distrust the judgments of those who are accustomed to lead them on other subjects than those of officers of Artillery or Engineers. The press representing the

* A second-hand set of the papers has for several months past encumbered the street stall of one of the shops leading westward from Holywell-street.

public are not merely the masters of Colonel Wilmot and Captain Alderson, but are the masters of their masters. That six months after the representatives of the press were insulted and driven from Shoeburyness no apology should be forthcoming to them is almost a reflection on the British Army; it certainly is so on Lord De Grey and the War-office. The press, Captain Alderson and Colonel Wilmot may rest assured, will keep their names in long remembrance, and not soon lose sight of them.*

* The useful treatise on ordnance and armour by Mr. Holley was put into my hands with the proof sheet of this chapter. A cursory glance at Mr. Holley's illustrations shows that he, an American, has, in the matter of illustrations, been more highly favoured than I, an Englishman. Two or three War-office photographs were all that I could secure in a backstairs manner: Mr. Holley appears to have had the whole collection of War-office photographs sent to him in New York. The communication of the whole collection of the War-office photographs to Mr. Holley was of course a revelation of the great secrets of the War-office prison house—to a foreigner. And yet, at the time when Mr. Holley was so highly favoured, the representatives of the press were placed under martial law by Captain Alderson and Colonel Wilmot. I say emphatically that in this matter the War-office treatment of the press demands early explanation.

To assist Lord De Grey in any inquiry he may set on foot, I may state that as the commission sent to America last year returned with a great number of drawings of guns, targets, and projectiles, it is possible that they were obtained by the exchange of War-office photographs, some of which, or a set of which, may have reached Mr. Holley.

T H E G U N S .

CHAPTER VI.

G U N S .

Official Incapacity.

I have long thought—not dreamily, but from observation, from statements which have been made to me, from Blue-books, and from other sources of information—that official incapacity and interest are at the bottom of the mystery, chicane, and robbery of the gun question. Our official system, however admirable in some respects, is opposed to fair dealing, to plain speaking, to the disinterestedness needful for advancing the scientific interests of a great country. It brings into prominence—nay, into the highest positions of trust and responsibility—two classes of persons who are just as likely to be unfit or unworthy as to be fit or worthy. The one class advances to trust and responsibility by seniority; the other class advances to trust and responsibility—rarely if ever by the force of genius—but invariably by the crooked means of patronage, influence, or bribery. I know men occupying the highest scientific

posts in the War Department at the present time much below the ordinary level of intelligence, and who, when called on for opinions, reports, or evidence, are regularly coached by their subordinates. That the gun question should be in its present apparently inextricable confusion, proves one of two things—either that the War Department does not possess a single man of parts on the establishment, or that if there are such men of parts on the establishment they are not in a position to command attention to their views.

What Guns Are.

Guns are tubes in which powder is burned that projectiles may be thrown upon near or distant objects. Roll a sheet of foolscap round a desk ruler, take it from the ruler, place the palm of the hand on one of the ends, call the palm of the hand a stepped or other screw, and you have a model of an Armstrong, a Whitworth, or a Blakely gun of the latest types, with paper coils. Take up a common spy-glass, extend it to the full length,—the thick part represents the breech, and the thin end the chase of all English, all American, all French, and all the other ordnance of the time. What shall I add? That in England only is there any fuss about guns; in America the largest ordnance and most formidable are produced any and every morning before breakfast. In England the diameter of the roll of foolscap and the thickness of the spy-glass are inventions which none dare infringe. In England the several thicknesses of the roll of foolscap are inventions in respect to number and inventions in respect to the material from which they have been formed. Next comes the inside of the roll of foolscap, which in America is round and smooth. In England there are (*Ordnance Report*, 1868, page 584,) the following, besides many

other patented manipulations of the inside of the roll of foolscap :—

1. Lancaster oval inside.
2. Experimental decagon inside.
3. Armstrong's three-grooved shunt inside.
4. Scott's three-grooved shunt inside.
5. Whitworth's hexagon inside.
6. Scott's two-grooved shunt inside.
7. Experimental two-grooved shunt inside.
8. Lynall Thomas's three-ribbed inside.
9. Scott's three-grooved inside.
10. Armstrong's ten-grooved shunt inside.

In a word, the inside is hacked and cut up, each back and cut being a patent. Next comes what is put in the roll of foolscap, which have (*Owen's Motion of Projectiles*, pages 12 and 13,) the following forms:—

FORM OF THE BODIES OF PROJECTILES.

1. Hemisphere, convex side foremost.
2. Sphere.
3. Cone angle, with the axis $25^{\circ} 42'$.
4. Disc.
5. Hemisphere, flat side foremost.
6. Cone, base foremost.

FORM OF THE BASE OF PRISMS OF PROJECTILES.

1. Triangle, base foremost.
2. Triangle, apex foremost.
3. Demi-ellipse.
4. Ogival.

Inventors of "other systems" must, unhappily for them, be passed over. I have heard of lawyers making out strange cases and doing strange things; but the carrion who feed upon the War-office, who prostitute the Patent law, who stand in the way of the proper armament of the country, are worthy of the official fostering from which they emanate, and in which they

live and move and have their being. Englishmen submitting to such a system may conscientiously claim with other pre-eminences the first place among the nations for supineness in officials and rapacity in private persons. Constantinople and Washington are places of inferior obstructiveness and speculation to Pall-mall and Woolwich.

Steel Guns—Prussian.

Krupp, of Essen, under what is said to be the heaviest steam hammer in existence, turns out steel guns in the solid block. He neither bores out nor rifles, and the Russians have been his chief customers. The War-office has bought several of the blocks, and one of them converted into a 7-inch gun is represented (1938 to 1942 *Anderson's Evidence*, 30th April, 1863,) as good a gun as gun could be—fired with full charges and heavy projectiles, sometimes at once with two or three projectiles. The French have also purchased and (71 *Colonel Gardner's Evidence*, 12th March, 1863,) have fired 3,000 rounds from a 12-pounder. But steel is a treacherous metal: two of the Russian guns have burst, and one of ours has burst, the steel parting into as many destructive fragments as cast-iron. The largest of the Krupp ingots has been for an 11-inch gun. Mr. Anderson, Sir William Armstrong, and Mr. Whitworth also are opposed to steel in blocks, if not to steel altogether (see *Evidence*), Mr. Whitworth's homogeneous metal or mild steel being inapplicable for guns of even 7-inch calibre.

Cast-iron Guns—American.

The cast-iron guns of Rodman*

* The Rodman guns are not to be confounded with the Parrott guns, although the Parrott guns are now cast on the Rodman system. The Rodman proper is an untwisted or unrifled smooth-bore; the Parrott proper is a rifled cast-iron gun. The failure of the

are manufactured in the following manner. A cone formed on a tube of cast iron is placed in the axis of the mould, the tube being water-tight and close at the bottom. Into the bottom of the tube a current of water is discharged for the cooling of the interior. From the mould the gun passes to the lathe, the boring machine, and the testing apparatus. All the United States field and garrison guns down to 4.2 inch calibres, are now cast hollow; and in addition to the 20-inch, 15-inch, and 13-inch navy guns, the smaller calibres for the navy are now produced in the same manner. The cost of the hollow-cast guns is comparatively trifling—the endurance unexceptionable. The quality of the guns will be best judged from the report of the chief of the Ordnance Bureau, Captain Dahlgren. Page 12, he says—

“Two new classes of guns are already in existence. One of these, the 15-inch, is actually mounted on board our ironclads; the other has already been tried at iron plates of $5\frac{1}{2}$ inches thickness, with an oak backing of 18 inches placed at 200 yards, through which its shot passed with ease. Meanwhile, the guns already on hand will be accommodated as far as possible to the new state of things, and it is satisfactory to know that a severe test proves the 9-inch and the 11-inch able to bear continued firing with solid shot, and charges much greater than those for which they were intended, the 9-inch one half greater, the 11-inch double the original quantity of powder.”

. Page 13, he says—

“The cannon used in England to fire at the Warrior target in April, 1862, was made of wrought-iron, after the design of Sir William Armstrong. It is said to have weighed nearly 27,000lb., and on the above occasion was fired four times with 50lb. of powder and a round shot of 156lb. The 11-inch gun weighs 16,000lb. (cast-iron), and in

Parrott gun proves no more than the failure of the Parrott rifling, applied to cast-iron guns. My opinion is that Rodman guns with the smooth-bore twist of the Lancaster, or the gas grooves of the Mackay, would be found to answer. I strongly recommend both forms of rifling to the attention of the United States authorities as the easiest and best forms ever likely to be produced.

proportion to its weight would be doing the same work as this Armstrong gun if it was fired with 31lb. of powder and a 93lb. shot. One of this class of guns now here has been fired 155 times as follows:—

22 rounds with 20lb.	} shot of 165lb. to 169lb.
101 rounds with 25lb.	
32 rounds with 30lb.	

"A charge of 30lb. is very nearly proportional to that used in the Armstrong 156-pounder, and the shot is 80 per cent. heavier than it should be relatively, and 13lb. absolutely than the shot of the British gun. The gun is not burst, nor does it exhibit any indication of giving way. The Armstrong gun is burst, and it gave way with a charge of 50lb. It is said to have been fired 160 or 170 times, several of which were with much heavier charges—60lb. to 90lb.; but of this we have no information here beyond what may have appeared at different times in the public prints. On another occasion an 11-inch gun was fired 500 times, of which 170 fires per day were made in two successive days, which so heated the gun that it was found to be warm 18 hours afterwards. No sign of weakness was detected.

"The 9-inch class in the ratio of the British gun should throw shot of 54lb. with 18lb. of powder. A gun of this class after 1,500 service charges (10lb.), and shells of 72lb., was fired with gradually increasing charges until, at the last round (22d) it burst with a charge of 20lb. of powder and 10 shot, together weighing in the aggregate 900lb."

Page 13, he adds—

"The endurance, therefore, of these cast-iron guns bears comparison with the best forged British guns of the latest design, and the model must therefore be good."

Page 14, he continues—

"It may be that the ratio of velocity to weight should be greater when iron and not wood is to be struck, which will be determined quite in season."

Page 10, he says—

"The initial velocity of a cast-iron shot of 169lb. with 15lb. of powder is about 1·120 feet per second; the initial velocity of a cast-iron shot of 186lb. is 1·050 feet per second."

I make these quotations, not at second-hand, but with the report of Captain Dahlgren in my hand, and I may

state that the American officer who gave me the report said that he received it officially, and that he believed it was the only copy that had yet found its way to Europe.*

Built-up Guns—English.

America has one Rodman, Prussia one Krupp, and England one Armstrong. Recently the most noisy enemies of Sir William Armstrong (Mr. Whitworth and Commander Scott included) have complacently swallowed the leek of trying their forms of rifling on Armstrong built-up guns, because no other guns were strong enough to bear the strain of such trials. The end of Mr. Whitworth's claims may be gathered from his own words (7th May, 1863—*Ordnance Report*):—

"2582. Now, as the cast-iron gun of 1858 did not succeed, and the homogeneous metal gun of 1859 did not succeed, have we anything before us to show the correctness of your principle beyond the 70-pounder which was made on the coil principle (Armstrong), and was tried at Shoeburyness?—Yes, there is a 12-pounder.

"2583. But I am speaking of large guns?—That was the only one we had made.

"2584. And that gun likewise for the same cause burst after a few rounds, did it not? I mean the last gun made with wrought-iron?—The 80-pounder did not burst; the tube inside was cracked.

"2585. But still, that gun is considered unserviceable, is it not?—Yes.

"2586. Do you know how many rounds it has fired?—No; but a good number.

"2587. Was it thirty?—More than that, I think.

* Since the date of the report, guns of even larger calibres have been successfully produced. The success, I am assured, leaves nothing to be desired—rendering it superfluous and unwise to resort to steel blocks or to built-up guns. As those gentlemen who catch at everything are likely to lay down against rifling a general principle from the unrifled Rodmans, it may be well to state that the necessity of producing a great number of the heaviest guns has subordinated rifling in the United States. The earliest leisure moment will be given to the rifling of the Rodmans, because the spin of the round shot is as obsolete as the spin of the stage coach cart-wheel. They who are opposed to rifling are opposed to progress; and the opponents of progress have always been numerous, and possessed of a certain influence.

"2588. We have it in evidence before us that it was not thirty, but that it might have been twenty?—We fired it at Southport more than that before it was sent to Woolwich.

"2589. How many times did you fire it at Southport?—I do not remember.

"2590. I am now referring to the gun that went straight from Woolwich to Shorncliffe?—I have been speaking of the 5½-inch gun.

"2591. My questions have referred to the 7-inch gun that did not stand thirty rounds?—Does the honourable member mean the gun that was made at Woolwich?

"2592. Yes; I ask you this as the cast-iron gun burst so readily, and as the homogeneous iron gun burst, and as the wrought-iron gun made on your principle is also unserviceable, have we anything before us, except the gun I have mentioned, by which we can judge of the correctness of your principle?—My reply would be that the homogeneous gun did not burst."

The Whitworths.

Side by side with this question and answer between the Select Committee and Mr. Whitworth let the following facts be placed. Describing the 70-pounders brought forward by Mr. Whitworth in the recent Armstrong and Whitworth competitive trials, I made use of these words:—"First, there is a steel barrel, and next a series of steel hoops, forced on from the muzzle to the breech, in four separate layers or courses. Second, the breech is closed by a stepped screw. Third and last, the gun is sighted with all the latest improvements of Sir William Armstrong. Such a gun Mr. Whitworth has not before produced. It is as much a built-up gun as the Armstrong, and therefore embodies all the merits or demerits of the built-up principle. That Mr. Whitworth has a perfect right to make whatever changes he thinks proper I am not prepared to say; but what in the interest of truth and justice should be known is, that the Whitworth 70-pounder is quite a different weapon from what it was

supposed to be. The weight of the gun is 76 cwt.; its major axis is $5\frac{1}{2}$ inches; its minor axis 5 inches; and its charge of powder is 10lb."

The Armstrongs.

And speaking of the Armstrong 70-pounders at the same time, I said—"The shunt 70-pounder is, in construction, identical with the 3-inch or 12-pounder, the 10-inch or 300-pounder, and the 13-inch or 600-pounder. The principle of the shunt, it will be remembered, is the placing of the shot or shell in the barrel of the gun, along one set of grooves, which shunt—a railway phrase—the shot or shell into the grooves along which the shot or shell is to be discharged. It seems a roundabout process, one at which we may indulge in a passing sneer or joke; but, as in railways, shuntings are a wise provision, so from the fact that on the shunt principle you can make a gun, from a 12-pounder to a 600-pounder, it appears to follow that the shunt principle possesses the rather unusual merit in most guns of being practical. It is, besides, a principle of rifling that admits of the use indifferently of smooth-bore and rifled ammunition. From the 600-pounder shunt gun you may fire a 600lb. long shot, or a 300lb. round shot. From the 8-inch shunt gun you may fire a 150lb. long shot, or the identical service 68-pounder round shot and charge. Last of all, from the 6.4-inch shunt gun you may fire a 70-pounder long shot, or the identical service 32-pounder round shot and charge. That these are important considerations in an economic sense it would be idle to argue or dispute; for if smooth-bore firing is to be preferred to rifled firing, the adoption of the shunt gun implies not a farthing outlay for special ammunition. It would not be a bad idea, now that Mr. Whitworth has followed Sir William

Armstrong in built-up guns, to consider whether he could not improve the shunt, without detriment to the use of the service ammunition of the smooth-bore guns. To smooth-bore guns the hexagonal ammunition can never be supplied."

The Armstrong system of construction, as given in evidence before the Select Committee on Ordnance by Sir William Armstrong (3487 to 3494, 1st June, 1863), is—The internal tubes are made either of steel or coils—the coils as an alternative when steel is not to be obtained—the external part of coil exclusively. Mr. Whitworth has disputed Sir William Armstrong's claim to the invention of the coil system, stating that it was previously applied to an unfinished fowling-piece by himself. Sir William Armstrong denies that the coil system, as applied by him to guns, was previously used in the manufacture of hydraulic presses. Sir William Armstrong disclaims the infringement of Captain Blakely's system, or any imitation of it. Sir William Armstrong further denies the similarity of the coil-welding system with the hooped invention of Professor Treadwell, of the United States.

The Three Great Construction Systems.

Such are the three great systems of gun-making. The first, the Krupp system, is open to two objections: uncertainty in manufacture and terrible destructiveness in the battery in case of bursting. To the manufacture of steel I have given some attention—conversed with most men at home and abroad whose opinions are worth knowing—and I have no hesitation in affirming that which Mr. Whitworth and others so far have found out practically, namely, that steel, whether mild or severe, soft or hard, will always, from the conditions of its manufacture, be

perfectly worthless for large calibres on the Krupp system. They must always be as untrustworthy as similar calibres of our own frying-pan cast iron. If Mr. Whitworth and others will still prophecy, I would remind them that this is the year of grace 1865, not the age of the Mosaic law and Judaism. These are the days of cheap newspapers; the days of educating the masses to that standard, if to no higher one, at which prophets are likely to receive more kicks than halfpence. At one time it was thought a great advantage to possess lightness in steel guns: woe betide those who will stand behind a light steel gun when the charges range from 70 to 100lb. The Russians have found that out practically, and have recently begun the casting of hollow guns on the Rodman system. This the Russians have done, to all appearance turning their backs on the built-up system.

The Rodman system is not, in my opinion, open to one serious objection, in the face of the testimony of Captain Dahlgren. I see no difficulty in the way of rifling the Rodman guns, although the rifling would no doubt reduce the calibres, or increase the weight of the guns; but increase of weight is no objection to position guns, and reduced calibres for naval guns would be balanced by more steady flight and greater length of range. The advantages of the Rodman gun are the paramount ones of easy and rapid production at a greatly reduced cost.

The built-up system demands the same care in the manufacture as the Krupp blocks, but it is the care of parts, not at the same moment of time of the entire structure. Hence the obvious superiority of the built-up system to the Krupp system. Indeed, there can be no stronger condemnation of the Krupp system than the fact that unless the parts of a built-up gun are perfect in material and workmanship, the gun is unsafe, and there-

fore worthless. The dependence on perfection in material and workmanship is in turn the weak point in the built-up system. To secure those perfections is the only valid reason that can be offered in defence of the manufacture of guns by a government, in preference to contracting or purchasing in the open market. And to my mind, a gun so delicate in its organisation, if the expression may be allowed, that any one cannot be trusted with its manufacture, is, for that reason, if for no other, an unsuitable weapon for the considerable and constant requirements of a great Power. But to do no injustice to Sir William Armstrong, his manufacture of guns has been most successful. I confess that behind no other guns do I stand with half as much confidence. Sir William Armstrong has, I believe, from first to last, acted on the soundest of all commercial principles—that, namely, of taking time, doing well that which is to be done, that is as far as practicable, and charging a good price. He does what Maudslay and Penn have practised with so much success in engines, and what Dent and others have practised with like success in watches. Unfortunately for the built-up system, it has not always been in so good hands as Sir William Armstrong's. In Denmark and in America the built-up guns of other makers have failed in the hour of need, when those of Sir William Armstrong would have rendered good service.

The obvious Official Duty. The obvious official duty from these facts—those facts not of to-day, nor of yesterday, but of several years' standing—must be apparent to every man of common sense. We should have long since got beyond billing and cooing, first with Sir William Armstrong, next with Mr. Whitworth, and

afterwards with some one else. We should have long since possessed a gun "policy." We should have long since possessed a stock of guns of large calibres, instead of one experimental 600-pounder, and a handful of experimental 300-pounders. Instead of being unarmed; instead, for example, of being unable to hold the Thames, the Clyde, the Tyne, or the Mersey against an iron-clad enemy—which is our present state, and will be our state for months to come, although official lethargy were cast off to-morrow—we should have been inconvenienced with an overstock of guns of great calibres and ready ammunition for them. I hope that, with the information now before the public for a correct judgment on the gun construction question, the country will soon be in possession of a gun "policy."

But I confess that the prospect is far from cheering. There are no great changes in England without pressure, and there is rarely pressure without calamity. Were we at war with America or France, the right thing would be done instantly; but, until that good time comes, if the expression may be allowed, the probability is that official incapacity, misrule, and corruption will hold their own. Nor is it to be forgotten that the built-up gun interest is an institution at Woolwich, Elswick, Manchester, and elsewhere. Capital has been invested in the manufacture to the extent of millions; and Sir William Armstrong, Mr. Whitworth, and the whole built-up gun fraternity will no doubt fight as resolutely and persistently as the Protectionist paper-makers. Before the built-gun interest goes to the wall, Sir Emerson Tennent is sure to write another book sounding the praise of his friend. His friend, like William of Orange, is also sure to die in the last ditch.

The Testimony of the Select
Committee, 23d July, 1863.

At page 4 of the Report they state—"It appears that the experiments with the Whitworth gun were not of as extended a character as those with the Armstrong gun. At that time Mr. Whitworth had not any gun of his own construction, nor did he propose any system of constructing guns. He had only rifled Government blocks of brass and cast-iron. The system proposed by Mr. Armstrong was therefore the only complete one before the committee.

Evidence, 1863.

"On the other hand Mr. Armstrong proposed a method of constructing a gun which rendered it capable of enduring the strain to which rifled ordnance is submitted. This method was certainly at that time the only one capable of fulfilling that condition, and your committee have had no practical evidence before them that, even at this moment, any other method of constructing rifled ordnance exists which can be compared to that of Mr. Armstrong. In combination with his system of constructing or manufacturing a gun, Mr. Armstrong had introduced to the notice of the Government a plan of breech-loading, the gun being rifled on the old polygroove system, which involved the coating of the projectile with soft metal. This combination of construction, breech-loading, rifling, and coating the projectiles with soft metal, came to be viewed as the Armstrong system. The range and precision of the gun were so vastly superior to all field ordnance known at that time that, after careful and repeated trials, the committee appointed to investigate the question recommended its adoption as the field gun of the service. Your committee are of opinion that the adoption of the Armstrong gun by the Secretary of State for War for special service in the field was fully justified."

From what has been already said, it is once for all to be understood that the Armstrong system of construction is, with trifling variations, the sole one for any kind of built-up guns; just as raising walls and roofing the walls in is the only recognised way of building houses.

The Testimony of the Interested.

The testimony of the interested—those with inventions or crotchets of their own, or with professional aims in view—is very curious. Admiral Halsted's lectures at the United Service Institution and his letters to the *Daily News* are the most spirited and spicy. He has been the Manhattan of the Armstrong system, saying the strongest, the weakest, the funniest, and the flatest things about guns that ever imagination dreamed or pen and ink inscribed. If the gallant Admiral had got his way, Sir William Armstrong would have been restrained to his first gun, his first rifling, his first shot, and his first shell, either by Act of Parliament or by injunction of the Court of Chancery,—the gallant Admiral would not have cared which. His was—

“The watch-dog's voice that bayed the whispering wind,
And the loud laugh that spoke the vacant mind.”

Captain Fishbourne has done the heavy parts, and these have chiefly consisted of letters to the *Times*: grave contributions conveying the impression that there are other guns besides those of the Armstrong—namely, Scott guns and Lancaster guns, when in truth the latest appearance of Mr. Lancaster, as will appear hereafter, is in the borrowed plumes of an Armstrong barrel and Armstrong coil reinforces—in other words, in the Armstrong garb. The only appearance of Commander Scott, as will also appear further on, has been in the same attire; his first and last appearance as a gunner

being the use of the very weapon that he may abuse, but is not able to supplant or rival. When Captain Fishbourne wrote last to the *Times*, on the 23d August, 1864, he made use of, without acknowledgment, the erroneous tables supplied to me by the Ordnance Select Committee.

One word more. In Commander Scott's last appearance as a lecturer in the Alexandra Rooms, Blackheath, on the 29th December, 1864, he is reported, I believe by himself, to have said, "The coils of the latter (the Armstrongs) were put on at great tension, and the consequence was that when struck even with small shot the hoops broke. The enemy would have only to fire grape shot, and they would knock out the muzzles of all such guns." I do not think Admiral Halsted's feelings ever carried him into so shallow water. Commander Scott throws dirt at Sir William Armstrong, because apparently he, Commander Scott, does not like Sir William Armstrong, and because he, Commander Scott, is himself an inventor, not of a gun, but of what he considers an improvement of the shunt-rifling, at which improvement Sir William Armstrong has unwisely sneered. Commander Scott, Captain Fishbourne, and Admiral Halsted carp at what they believe to be the salient points of Sir William Armstrong's construction, rifling, or projectiles, and ungenerously—to the public—generalise their carpings, whether of projectiles, rifling, or construction, into a conclusive condemnation of Sir William Armstrong and all that he has done. The testimony of the interested is therefore a logical confirmation of the statement of the Select Committee, and of the knowledge of all who have happened to be behind the scenes.

Perfection.

But I shall be told that the Armstrong system, and that all systems, are imperfect; that in the progress of science the future will be marked by the same giant strides as the past. Impossible, say I. Watt's invention gave us, on the whole, a decent steam-engine; the old 68-pounder was, on the whole, a decent gun. Who will now add a cubit to the stature of the steam-engine? who, outside of Covent-garden, paints the lily? Sir William Armstrong has carried the construction of built-up guns to perfection; and I insist that, as there is but one mode of vaccination, so there is but one means of casting guns hollow. About the future of steel I confess to some uncertainty, so that there is no saying what Krupp will yet accomplish; but it is improbable that solid block guns will ever be preferable to built-up guns, when the calibres exceed 7 inches.*

* It is worth while appending my remarks on the small and large bore guns employed against the Lord Warden target. The advantage was greatly on the side of the large bores, for which Sir William Armstrong has always contended, and against the small bores, for which Mr. Whitworth has always contended.

The Lord Warden target was tried at Shoeburyness yesterday, and so were the guns used in the firing—the Somerset gun against the Frederick gun, and the gun-factory gun against the Armstrong 300-pounder. The combination was one of unprecedented interest and importance. As regards the guns, the points to be determined were, first, whether the 6½-ton Somerset gun of 9·22 inches bore, or the 6½-ton Frederick gun of 7 inches bore, possessed the greater destructive power; and, second, whether the 12½-ton gun-factory gun of 9·22 inches bore, or the 11½-ton Armstrong gun of 10½ inches bore, possessed the greater destructive power. Then the results of the two pairs of guns would show whether the 6½-ton guns, or the 12 odd ton guns did their work better. Let us for a moment speak of the guns. The Somerset gun originated in this sort of way. One day his Grace the Duke of Somerset, puzzled what to do about the armament of the navy, asked that a gun limited in weight to 6½ tons for ship use should be produced, with the *maximum* of penetrative power. This is all that his Grace had to do with it, but, out of compliment to him, the gun bears his name. It is a very shapely ship gun, of the Armstrong tube and coil construction, and of the Armstrong shunt rifling. The Frederick gun owes its origin to the same demand of the Duke of Somerset, but embodies Admiral Frederick's small-bore gun theory. The gallant admiral has long supposed that by the use of a small-bore, as compared with a large-bore, in guns of the same construction, more penetrative power would be obtained, because the greater mass of metal in the small-bore gun would admit of heavier charges than in the large-bore gun. This is all that Admiral Frederick has to do with the gun, and the gun itself, like the Somerset, is constructed on the tube and coil principle of the Armstrong, with shunt rifling. Unlike the Somerset, the Frederick is an unsightly gun. About and behind the trunnions it is a rounded mass of Armstrong coils, Mr.

Indeed, I am not sure that the 300-pounder—the 10·5 inch—is not the best outside size for general purposes on sea and land, so much more easily is that gun handled than the 600-pounder, and so effective are the shot and shell, when the gun is strong enough to be fired with high charges, and with such capacious and destructive common shell as those of Sir William Armstrong.

Anderson, of the gun factory, sharing Admiral Frederick's views, but pushing them to the extent of affirming that if you twist an inordinate amount of coil about and behind the trunnions you may, in addition to the general advantage to be derived from the small bore, obtain a gun into which you may put as much powder as you please without any risk of bursting. Such are the first pair of ship guns: they are Armstrong shunt-muzzle guns, of the same weight, but of different calibres. Then the heavy factory gun, or the Anderson, as it has been called, is identical in pattern with the well-known Armstrong 300-pounder. From the Armstrong it differs only in the bore, and in the substitution of a steel barrel for a wrought-iron barrel, the barrel on which the first and other layers of coil is laid. Recent improvements or extensions in the manufacture of steel have enabled Mr. Anderson to make this change, as Sir William Armstrong has done of late, and as Mr. Whitworth, following Sir William, has also done in his built-up 70-pounders. The second pair of guns, therefore, like the first, are Armstrong shunt-muzzle guns, nearly of the same weight, but differing, as before, in calibre.

CHAPTER VII.

RIFLING.

What it Is.

Rifling is a contrivance which, whatever its forms, is intended to do one and the same thing—namely, to impart to projectiles a motion identical with that which is given to a common bottle screw when put into a pale ale or wine cork. It imparts to projectiles the common screw motion. There are three leading systems of rifling—1st, by plain spiral grooves, which may be broad or narrow, and may be accompanied by a shunt or other contrivance; 2d, by imparting a spiral to angular borings, as in the Whitworth rifling; 3d, by spiral ribs in the bore of the gun, into which corresponding hollows on the bodies of the projectiles are made to fit, as in the Lynall Thomas gun. Any form of rifling may be given to the bore of a gun during the working hours of two days, and a gun rifled in one way may be readily rifled in another way, by merely boring out the first rifling and substituting the second. Re-rifling a gun, however, reduces the metal of a gun, and should only be attempted when there is sufficient metal for cutting and carving, or when guns are to be used with reduced charges. Rifling a gun is, therefore, a much less serious matter than is generally supposed.

It is one of the misuses of language that we have come to name a gun by the accident of its rifling instead of by the system of the make of the gun. The inventors or contrivers of rifling are responsible for the wrongful appropriation.

Wherein it Differs from
Smooth-bores, so called.

Rifling differs from smooth-boring, so called, in this, that when the smooth-bore, so called, is completed the gun is a finished weapon. There are neither ribs nor hollows nor cuts of any kind in the smooth-bore, so called. But the great difference between a rifled and unrifled gun is in the motions of the projectiles. Rifling gives the common screw motion: smooth-boring, so called, gives the motion of a boy's top. The last is a spinning motion; the first a screwing motion.

The Utilities of Both.

The utility of the screw motion is practically demonstrated when a projectile strikes a resisting object—an armour-plate, a ship, a tower, or a fort. The screw motion continuing, the greatest possible penetration is obtained—penetration until the velocity of the projectile is entirely consumed. The projectile with a screw motion acts like an augur on the resisting object. The utility of the spin motion is practically demonstrated in the same manner. When an unrifled projectile strikes an armour-plate, a ship, a tower, or a fort, a mere blow is delivered which may penetrate or

* A friend, admitting the greater precision of language here introduced, recommended the substitution of vertical spin for the unrifled shot, and horizontal spin for the rifled shot. I think the public are more likely to comprehend my meaning than his, although his definitions are more philosophical than mine.

No wonder that the gun question has been so long obscure, when its elementary terms have no settled meaning. The separation of rifling from guns introduced in this volume is a great blow to the mystics.

not, just as it happens that the projectile has or has not sufficient force to push its way-through by mere pressure. If there is insufficient force for penetration, the projectile makes an indentation corresponding with the force, and rebounds in a condition corresponding with the goodness or badness of the metal—a cast-iron shot breaking up, a bad steel shot breaking up, a good steel shot being injured slightly or not at all. Rifling, in addition to giving a screw motion, imparts a steadiness to the flight of the projectile, inasmuch as the long body of the projectile in the transit along the barrel of the gun takes up the screw motion of the rifling, which of course it maintains to the end. The projectile of the smooth-bore, so called, spins loosely along the barrel of the gun, and maintains the loose spin throughout. Rifling, therefore, gives greater penetration, and greater steadiness and certainty of flight.

The Smooth-bore Rifle. But there may be smooth-bore rifles, and the Lancaster is one. The Lancaster rifling is a smooth-bore spiral, the projectile taking up the screw motion in its transit along the spiral of the barrel. Mr. Lancaster's claim to the invention has been disputed; and rather oddly, one day, after seeing Mr. Lancaster, I stopped at an old book-shop in Seven Dials, where I saw some books on guns, and the old man in charge told me that he was a great collector of such books, and that he sold Mr. Lancaster the book from which he obtained his celebrity. He added that Mr. Lancaster's enemies had offered him £10 if he would testify to the fact. Be the origin of the smooth-bore spiral what it may, it has the advantage of other forms of rifling in not weakening the barrel of the gun and in reducing the wear to a probable *minimum*. For, as the wear of a gun is in

proportion to the area and depth of grooving, and there being no grooving in the Lancaster, there are no lands offering less resistance than the unbroken smooth-bore surface in the combustion of the charge, and none to suffer should a shell happen to burst in the barrel. Mr. Lancaster, a most retiring gentlemanly man, has, I think, been too quiet about his gun, and I once told him so. His system applied to the Armstrong would give us guns of great endurance, and projectiles of large cylindrical capacity for bursting charges. But the time for that has, I think, gone by, even although Mr. Lancaster and Sir William Armstrong were willing, as I believe they are, to hitch teams together and turn out Armstrong-Lancaster guns of all calibres, as well as shunts. For built-up guns, it is doubtful whether there is a better combination, although for all practical purposes the Armstrong gun with the shunt rifling may be quite as good.

The Whitworth.

Mr. Whitworth, who originally laid claim to nothing but a form of rifling, is in rifling the antithesis of Mr. Lancaster. The Lancaster system is the pole of simplicity; the Whitworth the pole of complexity. The Lancaster system has not varied from the first; the Whitworth is perpetually varying. At the outset the inside hexagon was traced precisely; then the angles were smoothed, next touched, next the least thing rounded, next the rounding was a trifle more marked, next improved rounding, and last of all rounded rounding. These changes were necessary through the failure of the guns: the sharper the angles the greater the tendency of the guns to give way at the angles. Hence the anxiety of Mr. Whitworth to supersede a law of mechanics by the discovery of an unknown

metal, a homogeneous metal, so called—one which, if possible would be recreant to the properties of all metals—yield complacently to any strain which the genius of Mr. Whitworth in hexagons might choose to put upon it. The man who longed for the wings of the morning will be gratified about the same time as Mr. Whitworth. The man who would pay the National Debt without taking anything from any one or giving anything to anybody will arrive at a solution the same forenoon. Metal, Mr. Whitworth will find, is metal, just as eggs are eggs—although he were to attain the green old age of the patriarchs. The relatively greater range which Mr. Whitworth's form of rifling has occasionally attained has uniformly arisen from smaller bores and smaller sectional areas, and they have as uniformly been accompanied by the sacrifice of area of destruction in the case of shot, and of destructive effect in the case of shell. Precisely the same range is attainable under the same conditions of sectional area with any other form of rifling under the sun that merely succeeds in giving to the projectile the screw motion. When the Whitworth rifling, even under the conditions of small bores and small sectional areas is still, in this year of grace 1865, more destructive of the guns than of any other thing, the system may, with all conscience, be pronounced a failure.

The Mackay.

The Mackay rifling—the construction of guns being no part of the Mackay system—differs from the ordinary grooves, first, in the use made of them, and second, in the angle of the grooves, which is very great.* Along the Mackay grooves, no studs,

* See Appendix B for some information on the subject.

buttons, or ribs travel, for the centring of the projectiles—the grooves are channels for the gases of the charge on combustion, and the gases travelling along the grooves impart the screw motion of other forms of rifling. The projectiles of the Mackay rifling are therefore smooth: a matter of some importance in cheap and rapid manufacture. But to the extent that the inside of the barrel is grooved, the barrel necessarily, one would think, is weakened; although Mr. Mackay has offered to pay the expense of 20,000 rounds if his rifling—in a proper gun, of course, an Armstrong gun, at least—should give out before the rounds were fired. Should the contrary prove to be the fact, should it be the case that the windage adaptation system gives the *maximum* endurance and the *minimum* strain—with the usual rifled steadiness of flight, penetration, and length of range corresponding with the area of the bore, or what is the same thing, the area of the projectile—then it is not unworthy of consideration whether, if any change in rifling is to be thought of, the Mackay rifling ought not to be preferred.

Lord De Grey appears to have met Mr. Mackay in the true official spirit.* He appears to have conveniently confounded the Mackay form of rifling with gun construction, and to have replied to Mr. Mackay that *his* gun, on the mere ground of endurance, could not be entertained for experimental purposes. The

* Since the above was written, Lord De Grey has ordered an 8 12-inch 10-ton Mackay gun on board the *Excellent*, at Portsmouth, after proof and delivery at Woolwich. That is a step in the right direction, but only a step. As there is great variety in the Mackay grooves and projectiles, half-a-dozen guns, at least, should be under trial at once and simultaneously. The Lynall Thomas might be made use of, and from the odd experimental guns the others might be taken. Let Lord De Grey command that half-a-dozen guns be prepared in one week and tried in another week, and we shall get to the bottom of the Mackay rifling and projectiles in a fortnight's time—with a good committee.

truth is, that the guns rifled on the Mackay system are not Mackay guns, but built-up Mersey Iron Works guns. None could be better aware of this than Lord De Grey; but Lord De Grey feels himself to be in this position with respect to guns, that he cannot speak out like an honest man. He must screen himself behind a paltry and transparent subterfuge. Perhaps Mr. Mackay will not thank me for this advocacy of his claims, as he may desire to appear before the world as the inventor of a gun as well as the inventor of a form of rifling. But whatever Mr. Mackay may think, or Lord De Grey may feel, my duty is the obvious one of representing things not in a convenient and pleasant way, but as they really are. Whatever the merits or the demerits of the Mackay system of rifling, this at least is true of it, that it is as applicable to the Armstrong guns as to the guns of the Mersey Iron Works; probably it is better suited also for the rifling of the service cast-iron guns than any other system of rifling that has yet been tried. It may utilise our cast-iron guns in a better and cheaper manner than the steel lining of Major Palliser.

The Shunt Armstrong. The shunt Armstrong rifling system has, I believe, been partially adopted by the Russians and the French. It has also been partially adopted by ourselves, the handful of 300-pounders and the one 600-pounder being shunt rifled. As a system of rifling it is the most elaborate of any; and yet practically it is as simple as any. Its principle is this—the shallow grooves are in two distinct planes, which run into one another, or shunt into one another, at some distance from the muzzle, thence forming single planes. Along the deeper plane of each groove the projectile is passed in loading, and along the shallower plane of each groove

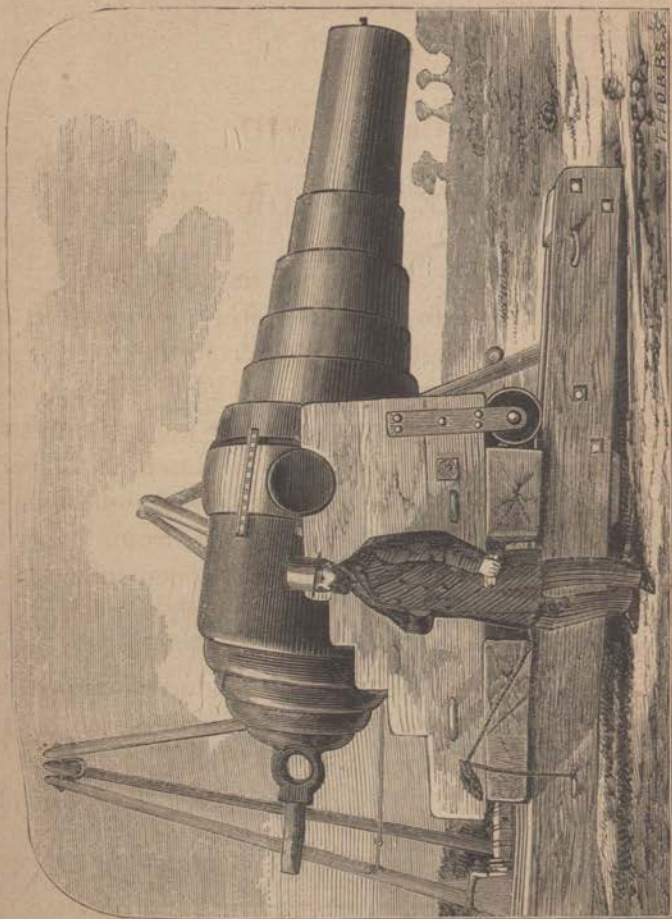
the projectile is passed when it is discharged. In other words, the projectile loads loosely and fires tightly; the tightening centreing the shot perfectly on its outward passage and insuring great accuracy in flight. And the outward tightening being obtained by soft metal studs, the endurance of the gun is maintained longer than can possibly be the case when the bearing of the projectile is as hard as the bearing of the gun; which is the case in the Lancaster, the Whitworth, the Mackay, and other forms of rifling. Mr. Lancaster and Mr. Whitworth, and no doubt also Mr. Mackay, aware of the objection to hard metal bearings,—proved in fact as it is every day by experiment,—rather shabbily take exception to stud bearings, and affirm that heavy charges will blow them out. I reply, without fear of serious contradiction, that if that is so, then the remedy is to be found in the deeper undercutting for the better holding of the soft metal. But if my report of the Bexhill bombardment is referred to, it will be found that, with the studs as they are, they passed through the Martello tower without injury. Should I be asked to reconcile what I am now stating with the previous hint of the possibility of an Armstrong-Lancaster alliance, the explanation is, that were Sir William Armstrong to abandon the shunt and adopt the smooth-bore rifling, he would at the same time abandon the advantages, such as they are, of a soft bearing projectile on a hard gun-barrel.

The Scott, or Bastard Shunt. The Scott rifling—there being no Scott guns—is sufficiently characterised as a bastard shunt. The shunt rifling, as just described, is for projectiles with soft metal bearings. The Scott rifling is practically a reproduction of the shunt rifling with pro-

jectiles whose bearings, instead of being soft metal studs, are hard metal ribs. The Scott ribs or bearings were designed to meet the imaginary defects of the soft metal studs; and the ribs are planed into the body metal of the projectile after the metal has undergone careful turning in the lathe. More tiresome or costly projectiles were never made at the Royal Arsenal, and were the ribs or bearings ever so serviceable for accuracy of flight, the expense of producing them would be an insuperable objection to their use. The Scott system in addition embraces a "nip" or notch in the rifling at the muzzle, the theory of which is the nautical one of a shot, like a ship, being all the better for a good departure. As the "nip" did not insure the success of the Scott rifling in the recent competition, it may be said to be as much a failure as the rifling.

The French.

The French rifling tried at Shoeburyness has consisted of three plain deep grooves, with the spiral necessary to give steadiness to the projectiles in their flight. As will be seen further on, it has practically answered as well as any other system; and for this reason, that all that the most elaborate system of rifling can do is to impart the screw motion to projectiles, and that can be imparted by very simple means. It is needless to speak of other forms of rifling. Their names are legion, but their utility is one, even if it is assumed that the forms are all useful.



THE ARMSTRONG 600 POUNDER.

(From a Shochburyess Photograph.)

CHAPTER VIII.

WHERE WE NOW ARE.

The 600-Pounder, 22 Tons. We possess one 600-pounder, and are not soon likely to possess another, although it has been some time proved that the projectiles of the gun will destroy anything whatever at 200 yards, and any ironclad afloat at 2,000 yards. The gun was taken in hand in May, 1862, and delivered in March, 1863, being ten months in hand. The gun consists of eight layers of coiled cylinders, varying in thickness from 2 to 2·8 inches. The barrel was first of all an open tube; afterwards it was closed at the breech with a plug. The rifling is the common shunt, and the projectiles are centred by six brass studs in each row; the studs stamped into shallow under-cut holes. The common shell of the gun are 30½ inches long, weigh 556¼lb., and carry a bursting charge of 42½lb. of dry powder. The principal dimensions are:—

	Feet.	Inches.
Extreme length	15	3
Length of bore	12	1·25
Calibre	1	1·3
External diameter over breech	4	3·5
External diameter over muzzle	1	9·5

Rifling one turn in 65 calibres.

First Day's Range Firing. The first day's firing of the 600-pounder gave the following results:—

RANGE.			
Rounds.	Elevation.		Range.
1	3 deg.	.....	1566 yards.
2	3 deg.	.....	1537 „
3	3 deg.	.....	1546 „
4	3 deg.	.....	1496 „
5	3 deg.	.....	1478 „
6	23 deg. 9	.....	7310 „
7	23 deg. 9	.....	7139 „
8	23 deg. 9	.....	7372 „
9	10 deg.	.....	3956 „
10	10 deg.	.....	4042 „
11	10 deg.	.....	3837 „
12	10 deg.	.....	4013 „
13	10 deg.	.....	3944 „
14	5 deg.	.....	2310 „
15	5 deg.	.....	2233 „
16	5 deg.	.....	2324 „
17	5 deg.	.....	2325 „
18	5 deg.	.....	2296 „

ACCURACY.			
Elevation.	Mean error of range.		Mean error in line.
3 deg.		16 yards	 1 2-3ds yards.
5 deg.		26 „	 8-10ths ditto.
10 deg.		54 „	 2·86 ditto.
23 deg. 9		89 „	 2 9-10ths ditto.

Better practice has been seldom made at Shoeburyness with small guns, and the gunners now handle the big gun more actively than before. To what extent machinery will expedite the firing remains to be seen. The opinion I have formed on the subject is that machinery will accomplish less than is expected, and that accurate laying and destructive effect are of more importance than machinery with heavy ordnance—one good blow being likely to suffice. Taking the time from my watch, after

the gunners had warmed at their work, the period occupied was—

SEVENTH ROUND.

4 minutes loading.
2 minutes getting in line.
1·30 minutes elevating.
—7·30.

ELEVENTH ROUND.

4 minutes loading.
2 minutes getting in line and elevating.
—6.

Water was put into the gun each round, and during the practice not fewer than fifty persons stood about the gun, unconscious of danger and apparently well pleased with the privilege of being present. The 600-pounder, at the close of the first day's firing, had then fired 44 rounds in all—namely, 36 rounds with 70lb. charges, three rounds with 90lb. charges, three rounds with 60lb. charges, and two rounds with 40lb. charges. The day after the firing proceeded up to 100 rounds, and the gun, so far, exhibiting no sign of wear—this is a statement from personal examination—there is no reason to doubt that the 600-pounder is good for 1,000 rounds. It is worthy of remark that on the occasion of the first practice with the gun the artillerymen did not get through their duties quickly. Taking out my watch on the occasion, I found that the charging and laying occupied twenty minutes, in other words, five-and-twenty or thirty artillerymen fired three rounds in an hour.

Common Shell.

At the time of the common shell trial of the gun I made the following remarks in my report:—

“The Ordnance Select Committee have busied them-

selves during the week with alternate trials of the 600-pounder and the 7-inch guns. Yesterday and on Thursday the 600-pounder received the exclusive attention of the committee for a variety of purposes—namely, the endurance of the gun, the velocity of its shot and two kinds of shell, the destructive effect of its projectiles, and the utility of the Armstrong and Boxer fuzes with high gun charges. As a whole these various trials have proved unsatisfactory.

“The fuzes did not act as they should have acted; the destructive effect may be said to be undetermined, and last of all the gun is unsuited for shell firing. The firing proves, what may have been supposed *a priori*, that as you increase the length of the projectile you must increase the spiral of the gun, otherwise the projectiles will wobble and may turn over. As much was demonstrated the other day in the trial of the Britten rifling in the Armstrong gun, but the largeness of the projectiles of the 600-pounder gave to all present ocular proof of the fact that with insufficient spiral, or, as it is sometimes called, twist in rifling, the flight of the shot from the muzzle of the gun onwards may be a succession of somersaults. Such a discovery is an important addition to the principles of rifled gunnery. The common shell of the 600-pounder, in size and shape, is not unlike an Essex sheaf of wheat, and such a body wobbling and turning in the air could not be mistaken. With bad fuzes such a projectile fired with insufficient spiral is likely to prove as dangerous to friends as enemies.

“Practically, therefore, the one 600-pounder is now a useless gun. True, it is still available for round shot, or segment firing from short shell, but it would surely be most unwise to mount so large a gun at the entrance of the Mersey or the Tyne when a gun of greater spiral

might be provided. The roadsteads and great commercial harbours of the country demand 600-pounder guns out of which $42\frac{1}{2}$ lb. of powder may be fired in elongated hollow shot, because one such blow would burn and sink any ship that swims, or that ever will swim. Segment shell, of short or long lengths, must in the nature of things be all but useless for 600-pounder guns, because if you may burn and sink any floating object, be it iron-clad or no, by hollow shot filled with powder, where would be the wisdom of contenting yourself with firing segments through open ports or into boats? Such half work would never do. When England goes to war its whole destructive power should be turned against its enemies, and inside of the common shell of the 600-pounder we can lodge no less a quantity than $42\frac{1}{2}$ lb. of dry powder. On Thursday afternoon an amusing conversation took place between Captain Heath, of the Ordnance Select Committee, and Captain Noble, of the Elswick Works, about the segments. Captain Heath thought them a useless waste of powder against the line of targets set up at 1,000 yards; but owing to the imperfections of the fuzes it was found impossible to strike the targets a single blow.

"But while as a shell-gun the 600-pounder is an admitted failure, let it not be supposed that the construction of a proper 600-pounder gun is difficult or impossible. The production of 600-pounders for at least a dozen good forms of rifling is as easy and certain as the production of 6 or 12-pounders. Of this fact the endurance of the 600-pounder under trial is the proof. When the gun was first mounted at Shoeburyness all nervous gentlemen, and not a few sanguine ones besides, were sure that the gun would burst. At last it was fired once, and no harm was done. 'But,' responded the

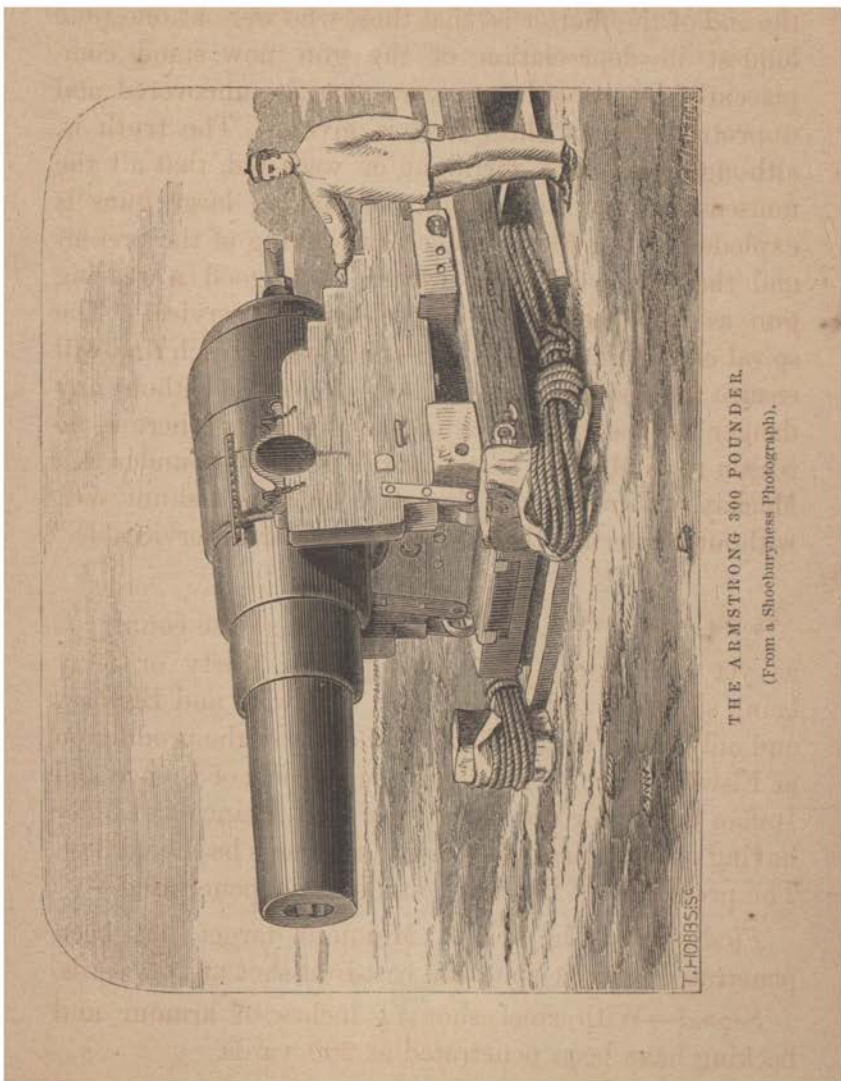
nervous gentleman, 'try again, and get well under cover when the string is pulled.' The try again followed, and the end of the matter is, that those who were at one time loudest in depreciation of the gun now stand complacently by its side, or very near it, uncovered and unprotected when the 'fire' is given. The truth is, although only of a fortnight or week old, that all the nonsense of the impossibility of making large guns is exploded. The 600-pounder, as the firing of the present and the past weeks has proved, is as good a wearing gun as is to be found in the Queen's service. The spiral of the gun may be increased to any pitch that will ensure the good shooting of long projectiles without any danger to the endurance of the gun; and there is no reason to doubt that you may rifle the 600-pounder as a Mackay, a Lancaster, a French, a Britten, a shunt, &c., without rendering the gun dangerous or unserviceable."

The 300-pounders, 12 tons. With 300-pounders the country is as yet (February, 1865) unsupplied; thirty or forty being supposed to be in hand at Woolwich and Elswick, and only five or six finished. In the way of the production at Elswick there is, I believe, the obstacle of French and Italian orders for the same gun, and France and Italy having ordered first, they must in fairness be served first. The projectiles of the 300-pounder have penetrated—

First—The side of the Minotaur target has been penetrated with a spherical cast-iron shot at 200 yards.

Second—With steel shot $7\frac{1}{2}$ inches of armour and backing have been penetrated at 200 yards.

Third—With steel shell, $5\frac{1}{2}$ inches of armour, 9 inches of teak, and a strong inner frame and skin have been penetrated at 200 yards.



THE ARMSTRONG 300 POUNDER.
(From a Shoeburyness Photograph).

In other words, the 300-pounder accomplishes at 200 yards exactly the same thing as the 600-pounder at 2,000 yards.

The Horsfall, 24½ tons. The Horsfall gun, with cast-iron shot, penetrated the Warrior target at 200 yards; but only pierced the armour of the target with cast-iron shot at 800 yards.

The 120-pounder. The 120-pounder, at 200 yards, indented the armour of the Warrior target, 3·1 inches.

The 100-pounder. The 100-pounder, at 200 yards, indented the armour of the Warrior target, 1·3 to 1·9 inches.

The Service 68-pounder. The service 68-pounder, at 200 yards, indented the armour of the Warrior target 1·5 to 1·8 inches.

The Whitworth 68-pounder. The Whitworth 68-pounder at 350 to 450 yards, indented the 4-inch armour of the Alfred 5·8ths inch.

The 68-pounders and the 32-pounders. In firing at 4-inch plates backed by 24 inches of oak, it was found that one 68-pounder did much the same damage as five 32-pounders.

The 68-pounder at 1,200 and 400 yards. At 1,200 yards, 4½ inches of armour on any backing is proof against the 68-pounder; at 400 yards the 68-pounder indents the armour 2·75 inches.

The Armstrong 70-pounder. The Armstrong 70-pounder does not penetrate the Warrior target at 200 yards.

The Whitworth 70-pounder. The Whitworth 70-pounder does not penetrate the Warrior target at 200 yards.

Conclusion.

There is but one conclusion from these facts, and that is, that small guns are good for small work, and that large guns are good for large work. How anything else was ever anticipated admits of no other explanation than the one that from first to last the official mind has been warped and muddled on the gun question. We ought by this time to have melted most of our small guns into shot, and been in possession of numberless guns of large calibre.

CHAPTER IX.

THE ARMSTRONG AND WHITWORTH
TWELVE-POUNDERS.

The Opening, 1st April,
1864.

All Fool's Day, 1864, was the opening of the famous Armstrong and Whitworth competition*. Mr. Whitworth and his even more zealous colleagues and business partners, the members of the Manchester Ordnance Company, had long sought satisfaction, and it was at length accorded to them. They were to demonstrate the superiority of the Whitworth guns to all others. They were to show that an error had been committed in adopting the Armstrong field guns; and that the British navy might be provided with a light and handy 7-inch gun, the shell of which would penetrate and demolish anything. The public hailed the appointment of the committee and the firing of the first shot with pleasure. They were convinced that Mr. Whitworth was a man of genius, and an injured man. They thought that Sir William Armstrong had enjoyed his turn, and

* There were three breech-loading and three muzzle-loading Armstrongs, and three muzzle-loading Whitworth's brought into competition; but one set of guns was only tried at once, instead of all the three. Latterly the sets were numbered A, B, and C,—the A guns for Shoeburyness, the B guns for Bexhill, and the C guns for Portsmouth. None of the 12-pounders were, however, tried either at Bexhill or Portsmouth.

that the turn of some one else had come. Officials appeared, for a time at least, and by the nominations to the committee, to share the popular feeling. Never was such a committee before constituted. The President, Major-General Rumley, an officer of infantry, knew nothing of guns. Mr. Macdonald, one of the business conductors of the *Times*, was a member of the committee, and knew nothing of guns. Mr. John Penn, the well-known engineer, was a member of the committee, and knew nothing of guns. Mr. Pole, of King's College, was a member of the committee, and knew nothing of guns. And so on. But one principle appeared in the nominations—friendliness to the pretensions of the Manchester Ordnance Company. The officials had been censured for indifference to Mr. Whitworth, and they seem to have made up their minds to allow Mr. Whitworth to be judged by his friends. If so, I am persuaded they knew what they were about. I believe they were well aware that Mr. Whitworth was ill advised in bringing forward his guns for trial, and that the end of the indulgence would be the undeceiving of the public. I believe the public will now feel that they have been trifled with. Mr Whitworth has established no superiority in field guns, and his 7-inch gun is ten years behind the times. Mr. Whitworth, instead of having a grievance, must now be regarded as a grievance. The public money has been spent on him—positively squandered on him—and, as far as I am aware, to no purpose. A greater sum may have been expended in the interest of Sir William Armstrong; but the return is a system of ordnance manufacture superior, some affirm, to any other system the wide world over. For the grants of the public money to Mr. Whitworth, and for the unknown expenditure of Colonel Boxer in behalf of Mr.

Whitworth there is absolutely nothing. And while the public money has been spent on Mr. Whitworth, other inventors have been repelled, trifled with, injured. So All Fool's Day was a befitting opening for the competition. A worthier cause might have been begun a month before or a month later.

Recoil Firing.

The recoil firing of the guns was—

FIRST ROUND.

	Feet.	Inches.
Breech-loading Armstrong	6	3
Whitworth muzzle.....	4	9
Armstrong muzzle.....	4	6

SECOND ROUND.

Breech-loading Armstrong	5	6
Whitworth muzzle	4	7
Armstrong muzzle.....	6	6

THIRD ROUND.

Breech-loading Armstrong	5	8
Whitworth muzzle.....	5	0
Armstrong muzzle.....	6	6

FOURTH ROUND.

Breech-loading Armstrong	5	6
Whitworth muzzle.....	4	10
Armstrong muzzle.....	6	3

FIFTH ROUND.

Breech-loading Armstrong	5	6
Whitworth muzzle.....	5	0
Armstrong muzzle.....	6	4

SIXTH ROUND.

Breech-loading Armstrong	5	9
Whitworth muzzle.....	4	11
Armstrong muzzle.....	6	4

Accuracy Firing.

The accuracy firing was—

AT 200 YARDS.

Breech-loading Armstrong, 5 shots in 21 inches by 21 inches.

Whitworth muzzle, 5 shots in 8½ inches by 9 inches.

Armstrong muzzle, 5 shots in 19 inches by 17 inches.

AT 300 YARDS.

Breech-loading Armstrong—

Shot scattered 25 inches, the extreme distance from the centre of bull's eye.

Whitworth muzzle—

All the five shot, as before, in the bull's eye.

Armstrong muzzle—

Shot not so scattered as with the breech-loader; worst shot 22 inches from the centre of the bull's eye.

AT 500 YARDS.

Breech-loading Armstrong—

Nearest shot to the centre of the bull's eye, 9 inches; farthest, 40 inches. Total measurement of the 5 shots, 119 inches. Four shots in line.

Whitworth muzzle—

One shot a bull's eye; farthest shot from the centre of the bull's eye, 31 inches. Shot a good deal scattered.

Armstrong muzzle—

Nearest shot to the centre of the bull's eye, 8 inches; farthest 24 inches. Shot very much scattered.

AT 600 YARDS.

Breech-loading Armstrong—

One shot missed; the nearest shot to the centre of the bull's eye, 20 inches. Three shot in a line; wide.

Whitworth muzzle—

The nearest shot to the centre of the bull's eye, 20 inches; the farthest, 30 inches. Shot all well in line, but wide.

Armstrong muzzle—

The nearest shot to the centre of the bull's eye, 12 inches; the farthest 36 inches. Shot well in line; wide.

AT 700 YARDS.

Breech-loading Armstrong—

Nearest shell to the centre of the bull's eye, 30 inches; farthest 54 inches. Shot all well together at the top.

Whitworth muzzle—

Two misses; nearest shell to the centre of the bull's eye, 12 inches. The 3 shot were in a triangular form above the bull's eye.

Armstrong muzzle—

Nearest shot to the centre of the bull's eye, 12 inches; farthest 36 inches. Shell well in line, and not much scattered.

AT 800 YARDS.

Breech-loading Armstrong—

Nearest shot to the centre of the bull's-eye, 20 inches ; farthest 48 inches. Shot very much scattered.

Whitworth muzzle—

Nearest shot to the centre of the bull's-eye, 17 inches ; farthest 48 inches. Shot less scattered than with the breech-loader.

Armstrong muzzle—

Nearest shot to the centre of the bull's-eye, 9 inches ; farthest 42 inches. Shot in good line ; much the best firing.

AT 900 YARDS.

Breech-loading Armstrong—

Nearest shot to the centre of the bull's-eye, 12 inches ; farthest 48 inches. The practice good, and the best of the three guns.

Whitworth muzzle—

Nearest shot to the centre of the bull's-eye, 12 inches. The farthest a $7\frac{1}{2}$ in. graze at the bottom, counted as a miss.

Armstrong muzzle—

The nearest shot to the centre of the bull's-eye 10 inches ; the farthest 2 separate misses.

AT 1300 YARDS.

Breech-loading Armstrong—

Wood target knocked down by shot, which struck 2 feet to the right at the bottom of the target ; distant from the bull's-eye $7\frac{1}{2}$ inches. A shot of this character counts $7\frac{1}{2}$ the wrong way, and is recorded as a miss.

Whitworth muzzle—

Shot in line, but struck the ground 2 yards short of the target.

Armstrong muzzle—

Shot in line, but struck the ground 7 yards short of the target.

The Field Works.

Before speaking of the field work effects, let me speak of the works in a few words. They were thrown up in 34 hours, and are such works as an enemy would first think of were he to effect a landing in this country. What may be called the gorge

of the works faced the sea, and on the face of the sea bank were erected a row of double wood targets to mark the shot and shell that passed through the embrasures. Back some 22 feet from the wood targets, on the interior slope, were mounted three unserviceable 32-pounders, which might be supposed to be firing on the brave defenders of their country among the adjacent rabbit-holes and sand-hills. Mounting the parapet, and looking down the exterior slope, there were the berm, the ditch, the palisade, the glacis, and the abattis. There was nothing wanting: the invaders were in a perfect field-work, in which three guns were mounted, and the embrasures rivetted with iron gabions. Such were the works, and against the right embrasure was laid the breech-loading Armstrong, against the centre embrasure the Whitworth muzzle, and against the left embrasure the Armstrong muzzle:—

AT 700 YARDS.

Breech-loading Armstrong with segment—

48 pieces through the rear-targets; 14 pieces lodged; 3 pieces glanced; 2 gunners killed.

Whitworth muzzle, Shrapnel—

14 pieces through the rear-targets; 1 piece lodged; 1 piece glanced; no gunners killed.

Armstrong muzzle segment—

26 pieces through the rear-targets; 2 pieces lodged; 3 pieces glanced; two gunners killed.

AT 700 YARDS.

Breech-loading Armstrong, common shell—

17 pieces through the rear-targets; 1 piece lodged; 8 pieces glanced; 1 gunner killed.

Whitworth muzzle, common shell—

14 pieces through the rear-targets; 5 pieces lodged; 5 pieces glanced; 5 gunners killed.

Armstrong muzzle, common shell—

1 piece through the rear-targets; none lodged; none glanced; 1 gunner killed.

AT 900 YARDS.

- Breech-loading Armstrong, segment and common shell—
65 target marks ; 5 gunners killed.

Whitworth muzzle—

58 target marks ; 3 gunners killed.

Armstrong muzzle—

20 target marks ; 1 gunner killed.

AT 900 YARDS.

Breech-loading Armstrong—

No injury to the wood targets ; 3 gunners killed at the gun ;
further damage to embrasure.

Whitworth muzzle—

No injury to the wood targets ; 2 gunners killed at the gun ; least
damage to embrasure.

Armstrong muzzle—

No injury to the wood target ; shot struck the gun ; 3 gunners
killed ; least damage to embrasure.

AT 1300 YARDS.

Breech-loading Armstrong—

Some shell splinters on the wood target. Two men killed at the
gun and 3 wounded ; no great additional damage to the
embrasure.

Whitworth muzzle—

No injury to the wood target ; no gunner hurt ; unburst shell in
front of the embrasure.

Armstrong muzzle—

Some shell splinters on the target ; no gunner hurt. Shell burst
in entrance destroying some gabions.

AT 1300 YARDS.

Breech-loading Armstrong—

One shot in the wood target 10 inches above the bull's eye.
Three men killed at the gun. Earth a good deal ploughed
up in embrasure.

Whitworth muzzle—

No shot in wood target ; no man disabled at the gun ; not much
earth ploughed up ; and two shot marks in front of the
abattis.

Armstrong muzzle—

One shot in the wood target 36 inches above the bull's eye, and
one shot 48 inches above the bull's eye. One man disabled
at the gun, and gabions slightly damaged on the left.

Abattis Firing.

The firing at the abattis was with segment, Shrapnel, and common shell.

SEGMENT AND SHRAPNEL.

Breech-loading Armstrong—segment.

Abattis opened sufficiently to allow troops to pass with ease.

Whitworth muzzle—Shrapnel.

Abattis practically uninjured.

Armstrong muzzle—segment.

Abattis opened sufficiently to allow troops to pass with ease.

The greatness of these results is only to be judged by comparison with the effects of common shell firing, the only means of destroying abattis that has been known or used hitherto. After the five rounds of segment or Shrapnel came five rounds of common shell, and the results were these :—

Breech-loading Armstrong—common shell.

Result *nil*.

Whitworth muzzle—common shell.

Result *nil*.

Armstrong muzzle—common shell.

Result *nil*.

Range and Accuracy Firing.

Of the range and accuracy firing Captain Dyer furnished me with the following statement, giving the figures in round numbers :—

AT 3 DEG. ELEVATION.

Whitworth muzzle range	1600 yards.
Armstrong muzzle	1600 „

AT 4 DEG. ELEVATION.

Breech-loading Armstrong range	1700 „
Whitworth muzzle	1900 „
Armstrong muzzle	1900 „
Average of both the muzzles	1930 „
Average of breech-loader	1750 „

AT 5 DEG. ELEVATION.

Breech-loading Armstrong	2000 „
Whitworth muzzle	2000 „

Armstrong muzzle	2000 yards.
Average of both muzzles	2200 „
Average of breech-loader	2000 „

TRIALS FOR ACCURACY.

Breech-loading Armstrong, slightly behind the others.

Whitworth muzzle	} equal.
Armstrong muzzle	

Rapid Firing. The rapid firing gave the following irregular results :—

Number of rounds.	Armstrong B. L.		Armstrong M. L.		Whitworth M. L.	
	min.	sec.	min.	sec.	min.	sec.
18	5	57	.....	8 28.	.....	6 55
20	7	5	.....	7 45	.....	7 51
20	7	30	.....	7 59	.....	6 54
20	7	57	.....	7 32	.....	5 52
20	6	20	.....	5 30	.....	5 52
—	—		—		—	
Total 98	34	49	.....	37 14	.....	33 24

Resumé. 15th June, 1864, and 22d February, 1865.

On the 15th June I published the following *resumé* of the practice, and now, the 22d February, 1865, I see no reason to change a single line:—"The three guns are pronounced good alike as regards manufacture and endurance. The Whitworth is declared the best shot and the worst shell gun ; and as regards accuracy, that is never likely to be determined, because the indulgent committee not having pre-determined anything with respect to the parallelograms, it is now, and always will remain, open to the competitors to insist on short and narrow parallelograms when either finds his firing close, or on long and wide parallelograms when either finds his firing wide. No doubt the public will be entertained hereafter with no end of dissertations in support and in condemnation of the course pursued by the committee, whatever that

course may prove to be. Assuming that the current Shoeburyness rumours represent the actual facts of the trial, so far, of the 12-pounder field guns, let us see how the matter stands. The guns are said to be good alike as regards manufacture and endurance. That is a plain proposition, and the obvious and incontrovertible inference that it suggests is, that the service field guns and ammunition—the field guns of the army and the ammunition for those field guns—should not be disturbed. The service breech-loader—a weapon in which the British soldier has the most implicit confidence—is in point of endurance and manufacture as good a gun as the shunt or Whitworth. For the army field batteries we neither require Whitworths nor shunts. I beg to congratulate the tax-paying public on this prospective fact, because the substitution of the shunt or Whitworth gun for the field batteries would render necessary a contingent outlay of some 2,000,000*l.* or 3,000,000*l.* for guns and ammunition. In the second place, the Whitworth is declared the best shot and the worst shell gun. This implies that the Whitworth fires best that which is not used on service in England, France, Germany, Russia, or America; and fires worst that which is universally employed—namely, shell. The Whitworth is a shot gun; the Armstrongs are shell guns; and shell, or case-shot, is the proper ammunition against an enemy's works, batteries, infantry, or cavalry. Against the brick walls and stockades, at any range you like up to the muzzle of your guns, the 12*lb.* solid shot makes at the best a useless gimlet-hole. Against a column of infantry it would commit one or two casualties if any person happened to be hit; and so against cavalry or the batteries of an enemy. Shell, on the contrary, commits less or more devastation, and one

12lb. shell may consign to the grave or the hospital 20, 40, or 80 men. Why Mr. Whitworth ever thought of perfecting a 12-pounder field gun for solid shot firing, or why the War-office ever sanctioned the trial of such a gun, perhaps demands explanation. In the third place, the doubtful accuracy of the guns is a refinement that I cannot comprehend. If in firing shot you hit a man in the head or body at any range up to 2,000 yards, it is absurd to insist that he shall be hit in the head or body and nowhere else; and if in firing shell you wound or kill every one within 20 yards, it is preposterous to demand that this 20 yards shall be a foot or so more to the front or rear, or to the right or left. Putting the three current rumours together, the logical conclusion they warrant is that the trial of the 12-pounders might with great propriety be brought to an early close.

“Let me next present the reader with a *resumé* of the two months and a half of the 12-pounder firing. The firing opened with firing at point blank for recoil, on the ordinary service platform. The result was that the Whitworth gun recoiled least. Then came the firing at 200 and 300 yards, with victory again on the Whitworth side; and the firing at 400, 500, 600, and 700 yards, with varying success, but inclining to the Armstrongs. So it was at 1,300, 800, and 900 yards, success and failure appearing as a rule to depend more on the eye of the gunner than on the rifling of the guns. For example, as long as Major Milman laid the guns the practice was good with all the guns; but as soon as the Elswick and Manchester Ordnance Companies' mechanics laid the guns, the firing from all the guns was not unfrequently very bad. I say disgraceful, because sometimes the recruit firing at Shoeburyness is really

excellent; and sometimes the Elswick and Manchester Ordnance Companies' mechanics missed the targets as often as they hit them. Indeed, one of the most useful lessons of the Armstrong and Whitworth trial is, that there is much less virtue in any mode of rifling, whether shunt or hexagonal, than in the eyes of the gunners. Indeed, he who will tell where in firing good guns end and good eyes begin will have a task before him of some difficulty. Firing for range gave place for a time to firing at earthworks and abattis. In such practice the shell guns succeeded and the shot gun failed. Sir William Armstrong's guns opened a road through the abattis; Mr. Whitworth's gun did not. Against the earthworks there really was less damage done than an enemy would easily have repaired; and when British soldiers are called on to attack earthworks more destructive guns than 12-pounders must be supplied to them. To tell the truth, against earthworks 12-pounders are of no use whatever, unless in so far as they would destroy abattis and palisades, and thereby enable a storming party to leap the counterscarp, ascend the scarp to the berm, and force their way inside the works, either by the cheeks of the embrasures or by the parapet. After the firing at the earthworks came the firing for range at various degrees of elevation, and the general result of that firing from first to last has been that at given elevations the Whitworth has the greatest range. That is to say, lay the guns at any elevation that you please, and the Whitworth will win; but you have only to give to the Armstrongs a slightly greater elevation and they in turn will win. In other words, the Armstrongs require higher elevation than the Whitworth to attain the same range. Whether the committee intend testing the absolute range of the guns

—that is, the absolute distance that the guns will carry at any elevation—remains to be seen. Obviously no other test is of much practical value, for as it happens ranges at given elevations are no test of the ultimate carrying capability of the guns. From range firing there was a temporary change to brick wall and stockade firing, and the general result as regards all the guns was that 12-pounders are too light at any range for such work. To demolish brick walls and stockades effectually 40-pounders or 70-pounders—in other words siege guns—are required. That this should be so was probably neither expected by Sir William Armstrong nor Mr. Whitworth; and as regards the public, they certainly expected that the Whitworth gun in particular would demolish them. In truth it, like the others, can demolish very little. After the ineffectual battering at the brick walls and the stockades the committee thought of rapid firing for 200 rounds. They have since repeated rapid firing, and still the guns hold out, although considerably over 2,000 rounds have been fired from each. At one time great importance was attached to the rapid firing, as showing which gun would perform the most work in the shortest time. The expectation was doomed to disappointment. The fact is, that one detachment may be slow and another fast; one active and another bungling. So it has happened that a slow detachment was sure to be last, and a fast detachment sure to be first, no matter which gun it was. And so also it has happened that an active detachment has succeeded when a bungling detachment has failed, from some mischance or other.

“Such is the Armstrong and Whitworth trial up to the latest time. To each gun there are six horses and three reliefs of men, or 27 men. In other words, Sir William Armstrong and Mr. Whitworth enjoy the gratuitous use

of 81 soldiers, besides officers, and 18 horses. The committee, with three exceptions, are officers on full pay, and the cash allowances, besides the other official expenses of the three exceptions, amount to 51*l.* 9*s.* weekly. The full and other pay of the committee probably exceeds 250*l.* a week, and soldiers' pay and cost of ammunition raise the aggregate expenditure to perhaps 2,000*l.* a week. In other words, the trial has already cost the public 25,000*l.*, and by the end of August will have cost 25,000*l.* more. The expenditure is on a most liberal scale. To the War-office let me represent the hard case of the gun detachments. Out of the small pay of the men there have been and will continue to be serious stoppages for new clothing. In fact, the trial is ruining the poor fellows. A further grant in their behalf would be well bestowed."*

* For the purpose of the firing three temporary platforms were laid down on the elevated ground that overlooks the long sea-range, and on the three platforms were mounted the three trial guns. To the right of the battery thus formed stood the breech-loading 12-pounder Armstrong; the service gun, weighing 8*cwt.* 1*qr.* 6*lb.*, measuring 7 feet, and having one turn in the rifling in 9 feet 6 inches. In the centre stood the muzzle-loading 12-pounder Whitworth, weighing 10*cwt.*, measuring 6 feet 8 inches and having one inch turn in 55 inches. To the left stood the muzzle-loading shunt 12-pounder Armstrong, weighing 8*cwt.* 3*qr.* 27*lb.*, and having one turn in 9 feet 6 inches. For the gun on the right there was the service charge of 1½*lb.*, and the service lead-coated shot; for the gun in the centre there was a 1½*lb.* charge, and the hexagonal mechanical fit shot; and for the gun on the left there was a 1½*lb.* charge, and the brass-button shot of the shunt gun. In a word, the Armstrong and Whitworth guns were tried against each other; and both besides against the service breech-loading 12-pounder.

CHAPTER X.

THE ARMSTRONG AND WHITWORTH
SEVENTY-POUNDERS.

The Opening, 1st June,
1864.

Fifteen rounds were fired from the 70-pounders* on, I think, the 1st June, the object being to enable Lord De Grey to state that the 70-pounder competition was then proceeding, as well as the 12-pounder competition. The fifteen rounds fired, the committee returned to the 12-pounders; and to the endless, and often senseless, disputes between the representatives of the Armstrong Company and the Whitworth or Manchester Ordnance Company. Into the merits of the disputes I shall not enter, and I warn the public against entertaining them. It is with the results alone that I and the public have to do; the means by which the results are obtained being irrelevant and bewildering. Sir William Armstrong and Mr. Whitworth had no restriction imposed on them but the uniformity of the weight of the shot and shell to be fired; they might have made their guns as they pleased, put as much or as little metal in them as they liked,

* As in the 12-pounder competition there were three sets of guns—the Armstrong wedge breech-loader, the Armstrong shunt muzzle-loader, and the Whitworth muzzle-loader. The sets were also A, B, and C—A guns for Shoeburyness, B guns for Bexhill, and C guns for Portsmouth.

rifle them with all the charges that experience or fancy might suggest, give them whatever bore they had a mind to, fire them if so disposed, from the rear, the muzzle, or the usual place, and devise whatever form of shot and whatever thickness of shell they thought would be most to their advantage. Such being the case neither competitor is entitled to be heard in explanation of this or that. As in the prize-ring, as on the race-course, so on the range at Shoeburyness, the man who comes to time when the other fails, the horse which passes the winning-post when the others are behind, and the gun that fulfils the ordinary requirements of the service in the most satisfactory manner, are the winners. What betting man, after a prize-fight or a race, would entertain or perplex himself with the probabilities or possibilities of different training, different weather, different state of the ground, different backers, different seconds, and so on. If he have won he gets his money, if he have lost he pays, and there is an end of the matter. A trial of guns ought to be as final. All that the public ought to care for is to see the names of the first and second gun chalked up, not exactly at the office of *Bell's Life*, but in such a book as this. If Sir William Armstrong or Mr. Whitworth is dissatisfied with the result their dissatisfaction should not be whispered beyond the circle of their private friends. Both have had too much done for them, and many quite as able and as good men have had too little done for them. I, therefore, invoke any sympathy the public may have to spare to those who really deserve sympathy, not to the monopolists who hitherto have received it all. Of Sir William Armstrong and Mr. Whitworth the public should not hear another word, and not another sixpence of the public money should be bestowed on either unless

in the usual way of business. Colonel Boxer, at the Royal Arsenal, should henceforth cease to divide his time between the public and the Manchester Ordnance Company, and either throw the public or the Manchester Ordnance Company overboard.

• The 70-pounders against the Warrior Target.

Against the Warrior target the 70-pounders made the following practice:—

“AT 800 YARDS.

“*First round* of the Whitworth pierced right through the plate, broke a bolt, did no further injury to the rear of the target; the rear end of the steel shot must have broken at the moment of impact, cutting into the iron all round the hole. Had this rupture not taken place, the rear face of the shot would have been flush with that of the target. This hit was on the middle plate.

“*First round* of the Armstrong struck the upper plate towards its middle and strongest part, driving in a disc of iron to the depth of five inches into the backing. It then dropped down at the feet of the target, leaving a clean circular hole. No injury in the rear of the shield; everything on this side was intact. The shot was slightly set up. Its lesser amount of penetration was probably due to the greater reactive force existing in that part of the construction.

“*Second round* of the Whitworth struck the middle plate towards its upper edge; penetration equal to that of the first shot; rupture of shot, none; its rear face flush with the burr. In the rear of target no sign whatsoever of injury, with the exception of two rivets and a bolt broken.

“*Second round* of the Armstrong struck the right edge of the upper plate, where the resistance could not be great; made a clean hole, and glanced away obliquely into the water. The platform of the shunt had given way, rendering the practice very doubtful.

“*Third round* of the Whitworth—a shell (steel flat-headed) containing 11lb. 14oz. bursting charge—struck the right corner of the lower plate, making an indentation $3\frac{1}{2}$ inches deep; no effect in the rear of the structure.

“*Third round* of the Armstrong—round-headed steel shell, containing 2lb. of powder—struck the centre of the lower plate. Indent $1\frac{1}{2}$ inches deep; it broke through a bolt.

"This closed the practice for Thursday; it was, however, resumed on the ensuing day, with the following conditions and results:—

"AT 600 YARDS.

"*Third round* of the Armstrong—25 minutes' elevation—pierced the iron slab and stuck in. No bolts broken.

"*Third round* of the Whitworth—solid steel shot, 46 minutes' elevation; the shot pierced the plate, taking an upward direction. No other injury done.

"*Fourth round* of the shunt—steel shell—indent two inches deep. No other damage.

"*Fourth round* of the Whitworth—steel shell—failed to go through. It broke a rivet.

"AT 500 YARDS.

"*First round* of the Whitworth—steel flat-headed shell—struck the middle plate, on a line corresponding with the only metal stringer introduced in the backing; indent very little; a bolt was broken.

"*First round* of the Armstrong—round steel shot 38lb. weight; charge 18lb. of powder—struck on middle plate in line with the same metal stringer; penetration 4 inches; the shot broke; a bolt was damaged.

"*Second round* of the Whitworth—steel shell—pierced the plate, and broke a bolt. The rear of the structure was as sound as ever.

"*Second round* of the Armstrong—steel shell, 21lb. burster—struck the edge of the lower and middle plate, pierced both, but failed to go through the backing. In the rear, 9 bolts were broken; the timber was moreover set on fire, the smoke issuing from under the target. This was by far the most signal success of the day, yet the target was as perfect in its resistance as before.

"Thus ended Friday's practice, leaving every one convinced that such calibres were inadequate for piercing the well-manufactured armour of the present day. It likewise proved the hopelessness of shell firing, except there be sufficient surplus of force to ensure the charge exploding when penetration is effected."

The Bexhill Bombardment.

As I was the only representative of the London morning press at Bexhill, the reproduction of my report will be interesting to those who have not read it:—

"As great importance is attached, by the Armstrong

and Whitworth partisans, to the bombardment of No. 48 tower at Bexhill, it is probable that, unlike the bombardments of August and November, 1860, the one of October, 1864, will not soon be forgotten. The bombardment of August, 1860, was of No. 71 tower at Eastbourne. At that time Sir William Armstrong was beginning to become famous, and the breaching qualities of his early guns were tried by the authorities. The guns were a 6-inch, a 7-inch howitzer, and a 40-pounder, those being the most formidable rifled guns of the period—that is, four short years ago. Great interest was felt in the result, not in this country merely, but throughout the length and breadth of Europe. And the result was brilliant beyond anticipation. At a distance of 1,000 yards, 170 rounds of shot and shell rendered the tower untenable—in fact, so effectually demolished it that the bricks were sold and forthwith removed. The early Armstrong guns blotted out No. 71 tower from the line extending along the whole Kent and Sussex coasts—from Folkestone to Seaford. Lord Herbert was at the time Minister of War, and the course he took ought to be printed in large capitals and suspended in the War-office. He received the reports of the firing at No. 71 tower, and instantly determined on a comparative trial of the smooth-bore ordnance then in the service. Orders were at once sent to Woolwich, and in the course of a day or two Lord Herbert received an estimate of the expense of the smooth-bore trial. Receiving the estimate, he glanced at the figures, took up a pen, and on the estimate immediately inscribed the words, “I order the trial to take place.” Lord Herbert was a man of business, and his loss has since been much felt. He boldly assumed the initiative in his own Department; not waiting to act on submissions or recommendations, and dis-

daining to be an instrument in the hands of committees. Accordingly the smooth-bore trial, ordered in the spirited manner just stated, took place in the November of the same year. For the occasion the great spherical navy shell of the old pattern, the 68-pounder, and the other approved arms, were brought into requisition; and they failed miserably. They practically were powerless against No. 49 tower, covering the face of it with small indentations, and inflicting no serious injury. The comparative trial clearly proved that one-sixth the weight of metal from rifled guns did the same work as six-sixths the weight of metal from smooth-bore guns. The victory was decisive, and Sir William Armstrong became the ordnance improver and inventor of the public. It is instructive to recall this, because in the endless and bitter disputes which have arisen on the subject of guns, the fact was lost sight of that the November trial in 1860 disposed of the smooth-bore question at once and for ever. People, in disputing about the construction of guns, the qualities of projectiles, and the claims of people other than Sir William Armstrong, forgot what had taken place under the direction of Lord Herbert, and now and then amused themselves with the assertion that after all the smooth-bore ordnance was the best, and the 68-pounder the only gun we had. The interest of Sir William Armstrong and Mr. Whitworth in the Bexhill bombardment of October, 1864, will, it is to be really hoped, keep us hereafter from forgetting the results at which, by experiment, we have arrived.

“Everything being in readiness, and the members of the Armstrong and Whitworth Committee on the ground, the firing opened with two rounds of shot from each gun to obtain the range. That was found to be 740 yards, and blind shell were then tried for penetration against

the body of the tower, in the quarters of the garrison where the wall is unbacked and seven feet thick. Fair hits were not readily obtained, the wind being at the time high, but the Armstrong shunt muzzle-loader and the Whitworth muzzle-loader passed blind shell right through the seven feet of brickwork. And strange to state, one of the Armstrong shunt shell was uninjured, the studs even remaining as firm as before. A second shunt shell had merely its conical part broken, the studs remaining uninjured as before. The Whitworth shell broke up entirely, although the shell was of the new third pattern, with the extra strong walls, and the still diminished capacity for a bursting charge. Whether the Armstrong wedge breech-loader (the charge of which is 11lb. less) passed its blind shell through the seven-feet brickwork has not up to the time of writing been ascertained. After the satisfactory hits with the blind shell came the trial of solid shot against the same portion of the tower. Hits were not at once obtained with all the guns, but shunt, Whitworth, and wedge all passed their solid shot through the seven-feet brickwork. In blind shell and solid shot penetration the three guns, therefore, may be pronounced equal; that is, up to the test furnished by the tower. But in destructive effect there is no equality. The Armstrong projectiles make much the larger holes and dislodge much the greater number of bricks. And that such should be the case is because, while the bore of the Armstrong guns is 6.4 inches, the hexagonal bore of the Whitworth gun is only 5 inches at the minor axis and $5\frac{1}{2}$ inches at the major axis. In other words, the area of the Armstrong projectiles is 41 square inches, against the 27 square inches of the Whitworths. Hence the larger hole of the Armstrongs, hence also the greater atmospheric resistance to the Arm-

strongs; and on the other hand, hence, also, other things being equal, the relatively greater continuing velocity of the Whitworths and the relatively greater penetration of the Whitworths. The shooting of all the guns was good, the shooting of the Whitworth on four occasions being so close as to drop four shots into the same hole. A few more rounds in the same spot would have opened out a veritable doorway through the seven-feet brickwork

“On Thursday forenoon the firing was resumed to obtain a fair hit at the solid 40-feet brickwork with the Whitworth, and compare with the shunt of the previous day, which had obtained a penetration of 4 feet 9 inches. After two miss fires the first shot was too high, and passed through the parapet. The second struck fair enough to gain a penetration of $8\frac{1}{2}$ feet, but the comparison has been deemed of no value, it being impossible to determine from the fractured condition of the tower above whether or no deflection in a weak direction had taken place. And necessarily the fractured condition of the tower above rendered another comparative shot impossible. For penetration into solid brickwork—brickwork 40 feet thick—nothing, therefore, has been determined, although all parties willingly concede to the Whitworth the possibility of greater penetration than the shunt, because, as is well known, and has already been stated, the Whitworth shot has a less sectional area than the Armstrong. Why there should be any difference between the guns may as well be here explained. The explanation is, that Sir William Armstrong and Mr. Whitworth were simply required to bring 70-pounder guns into competition, and left free to choose their own calibres. The choice, therefore, of Mr. Whitworth was a small-bore gun—for penetration;

and the choice of Sir William Armstrong was a large-bore gun—to combine with penetration the *maximum* effect from shell firing. To this fair statement of the case no exception will be taken by Sir William Armstrong, but it will no doubt be claimed on behalf of Mr. Whitworth that in special cases the relatively greater penetration of his shell obviates the necessity of so large a bursting charge. That, it may be answered, is still an unproved assertion, and one not likely to be soon assented to when the bursting charges of the two shells are compared. The bursting charges are—

ARMSTRONG SHUNT AND WEDGE GUNS.

4·12lb. bursting charge in each shell.

WHITWORTH HEXAGONAL GUN.

2·10½lb. bursting charge in each shell.

“The shot and blind shell practice being over, the next and last thing to be determined was the shell effects of the three guns. These, from the general state of the tower, were more or less inconclusive, although the elements of a sound judgment were by no means wanting. Without particularising the live shell rounds, suffice it to state that on behalf of the Whitworth shell a penetration of 5 feet 2 inches into the 7-feet brickwork is claimed before bursting; and that on behalf of the Armstrong shell a penetration of 5 feet into a portion of 9-feet brickwork is claimed before bursting. Thus, practically the shell penetration of the guns is the same. But in the effects there is very little similarity. The following effects of the first shell-firing will show the difference:—

ARMSTRONG LIVE-SHELL EFFECTS.

Exterior area of destruction, 5 feet by 4 feet; brickwork driven out, 9 feet; area of interior scaling, 6 feet by 4 feet—the scaling 9 inches deep all over.

WHITWORTH LIVE-SHELL EFFECTS.

Exterior area of destruction, 3 feet by 4 feet ; no interior destruction beyond the knocking out of bricks over a small area.

“A few rounds of shell-firing sufficed to destroy the possibility of all comparative effects. It only then remained to knock down the tower by salvo firing. Its tenacity was astonishing. Long subjected to the simultaneous fire of the three guns with live shells it yielded, its brick and mortar sparingly, and at the close of this report was staunchly holding out. But no garrison held the tower. Through a breach, up which a pony chaise might almost drive, the storm of fire and shell pelted momentarily, setting fire to the scanty woodwork which remained. To the visitors and country people the firing was highly gratifying. Country gentlemen in carriages, with friends and families, filled the adjoining roads, or raced across the course on horseback when the cease fire was sounded. Round the battery and in the battery the fashion and beauty of Sussex were assembled, and outside of the rope fence were the happy faces of the humbler classes. And from first to last no accident occurred. The firing of the competitive guns, as at Shoeburyness, was under the direction of that excellent young officer, Lieutenant Cruickshanks. The gun detachments, new to the guns, consisted of fifty men of the Coast Brigade Royal Artillery from Eastbourne, commanded by Lieutenant Robinson. Those fifty men arrived on Monday, received the stores and ammunition at the railway, and in the course of the day placed the guns in position, and placed everything in readiness for the next morning. Thus a battery of 70-pounders admits of being established in the course of a few hours on any part of the coast.”

The Portsmouth Firing. The Portsmouth firing gave the following results:—

RICOCHET—SHELL.

Gun.	Time between 1st and 2d graze. Seconds.	Deflections.	Remarks.
1. Whitworth, burst first graze.			
2. Shunt.....	4½ ...	3 deg.	
3. Whitworth ...	4¾ ...	3 deg. ...	Burst.
4. Shunt.....	9 ...	4 deg.	
5. Whitworth ...	1¾ ...	1½ deg. ...	{ Burst 4 deg. high after second graze.
6. Shunt, burst prematurely at 20ft. from muzzle.			
7. Whitworth ...	9½ ...	7½ deg. ...	
8. Shunt.....	1 ...	1 deg. ...	5 grazes.
9. Whitworth, burst on 2d graze; ½ sec. between grazes.			
10. Shunt.....	4 ...	1½ deg.	
11. Whitworth, burst 1st graze.			
12. Shunt.....	7¾ ...	4 deg.	
13. Whitworth, burst 1st graze.			
14. Shunt.....	1½ ...	1 deg. ...	3 grazes.
15. Whitworth, burst 1st graze.			
16. Shunt.....	5 ...	1½ deg.	
17. Whitworth ...	12 ...	8 deg.	
18. Shunt.....	7 ...	2 deg. ...	2 grazes.
19. Whitworth, burst in flight after 1st graze.			
20. Shunt, not taken.			

RICOCHET—SHOT.

Gun.	Time between 1st and 2d graze. Seconds.	Deflections.	Remarks.
1. Whitworth ...	6½ ...	4 min. 30 sec....	2 grazes.
2. Shunt.....	13½ ...	5 deg. ...	2 „
3. Whitworth ...	4¾ ...	1¾ deg. ...	3 „
4. Shunt.....	3 ...	2½ deg. ...	3 „
5. Whitworth ...	6½ ...	4 deg. ...	2 „
6. Shunt.....	5¾ ...	9 deg. ...	2 „
7. Whitworth ...	3¼ ...	3 deg. ...	5 „
8. Shunt.....	4½ ...	8 deg. ...	2 „
9. Whitworth ...	3 ...	2½ deg. ...	3 „
10. Shunt.....	4½ ...	9 deg. ...	3 „

RAPID FIRING.

Gun.	Number of rounds.		Time. m. s.
Whitworth	20	.....	10 10
Shunt (Armstrong) ...	20	without lubricators	10 5
Wedge (Armstrong) ...	20	.....	8 13
Whitworth	20	.....	10 19

INDEPENDENT FIRING.

Gun.	Number of rounds.		Time. m. s.
Shunt	20	.....	19 2
Wedge.....	20	.....	15 20
Wedge	20	.....	10 23
Shunt	20	.....	16 28
Whitworth	20	.....	14 5
Whitworth	20	.....	12 36

The Shoeburyness Firing. The Shoeburyness range firing, and the time of firing, were as follow:—

RANGE—ELEVATION, 21 DEG.

Whitworth	7,800 yards—Error	200 yards.
Shunt	6,460 yards—Error	100 yards.
Wedge	5,960 yards—Error	250 yards.

RANGE—ELEVATION, 9 DEG.

Whitworth	4,000 yards.
Shunt.....	3,700 yards.
Wedge	3,500 yards.

TIME—120 ROUNDS.

Round.	Whitworth.	Shunt.	Wedge.
20	27 min.	19½ min.	12½ min.
20	23½ min.	23½ min.	13½ min.
20	24 min.	24½ min.	13½ min.
20	18½ min.	22 min.	19 min.
20	19 min.	22 min.	12½ min.
20	20½ min.	16 min.	17 min.

CHAPTER XI.

THE MIXED COMPETITION 70-POUNDERS.

The Guns—opening, 13th
July, 1864.

The four competing 7-inch guns are admirable specimens of Woolwich workmanship. Four more slightly guns were never sent to Shoeburyness; probably four better guns were never made. The construction of all is identical; steel barrels strengthened with Armstrong coils. From the Whitworth 7-inch gun standing in position on the marsh they differ in this—that in place of steel the Whitworth barrel is of wrought-iron. Otherwise the guns are alike; the Whitworth 7-inch gun being Woolwich make and on the coil system. Unfortunately, as the Whitworth has a wrought-iron barrel, it could not with safety have been tried with the other guns, and it is a strange oversight of the War Department that a steel barrel Whitworth gun was not made with the others. Still, there is no doubt that with careful firing the Ordnance Select Committee will be able to pass judgment on the principle of the Whitworth rifling by the performance of the wrought-iron barrel gun. The difference between the competing 7-inch guns is solely in the rifling, the French rifling representing the system of zinc studs with a spiral of 1 in 37 calibres; the Scott rifling representing the system of long bearings with a

spiral of 1 in 42 calibres; the Lancaster rifling representing the oval system with a spiral of 1 in $51\frac{1}{2}$ calibres, and the Jeffrey-Britten rifling representing the expanding projectile system with a spiral of 1 in 115 calibres. All the guns are of the same calibre—namely, 7 inches; of the same weight—namely, 149 cwt.; of the same length of bore—namely, 126 inches; and are using the same weight of shot—namely, 110lb. The calibre, weight, and length of bore, correspond with the wrought-iron barrel Whitworth gun in position on the Marsh. On the shot of the French there are zinc studs, the shot of the Scott and the Lancaster are uncoated, and the shot of the Jeffrey-Britten is lead-coated. The Jeffrey-Britten fires two descriptions of shot.

The Committee Programme. The programme of the committee—the Ordnance Select Committee—was as follows:—

1. The committee will ascertain the initial velocity due to the following charges in each gun employing lubricators:—

- 5 rounds, 12lb.
- 5 rounds, 20lb.
- 5 rounds, 25lb.

Repeat the same without lubricators, but with a gummet wad placed between cartridge and shot, observing in both cases the recoil on a wet platform without compressor, observing the slope very carefully.

2. The guns will be mounted on garrison sliding carriages on traversing platforms, and fired down the range with charge 25lb., without wad behind the shot, but with the service lubricator and felt wad.

One preliminary round each, solid shot at 2 deg.

„ „ 5 deg.
 „ „ 10 deg.

3. Fire 10 rounds at 2 deg. elevation by spirit level from each gun, at marks at the same distance apart as the guns. Each gun to be laid directly on the mark, with no allowance for wind or deflection.

4. Repeat at 5 deg.

5. Repeat at 10 deg.

6. Each gun will now have fired 48 rounds with 25lb. charge, except the gun rifled for expanding projectiles, which will have fired twice that number, there being two descriptions of shot fired from that gun.

7, 8, 9. Repeat the practice at

2 deg.

5 deg.

10 deg.

as before with 20lb. charge, firing one preliminary trial shot from each gun at each elevation, completing 81 rounds for three of the guns, and 162 for the Jeffrey-Britten.

10. The bores and vents to be examined.

11, 12, 13. Repeat the practice at

2 deg.

5 deg.

10 deg.

with either 20lb. or 25lb. to compare with previous practice in respect to uniformity of range, making 111 rounds for three of the guns, and 222 for the Jeffrey-Britten. Bores and vents to be again examined.

14. The remaining nine rounds per gun of the first supply of solid shot (130), will be fired with such charge and elevation as the committee may direct with or without wads.

15. Ten projectiles of the first supply, which have travelled 200 miles, to be now fired with 25lb. charge at 10 deg.

16. Fifty shots of the second supply will be fired for the further test of the facility of loading, wear of the grooves, effect of fouling on the loading and shooting, and endurance of the guns with either 25lb. or 20lb. charges. Each gun will be separately tested.

17. Bore to be examined.

18. Each gun will then fire 50 rounds spherical cast-iron shot of mean gauge 6.90 plus or minus .02, with charge 15lb., to ascertain how far the several systems of grooving can stand the use of round shot, and how far they favour accurate shooting.

19. Bore to be examined.

20. The remaining fifty shots of the second supply to be then fired with either 20lb. or 25lb., as before.

21. Bore to be examined.

22. The committee reserve to themselves full latitude in the use of this second 100 rounds, to fire them in such a way as to bring out the strong or weak points of any one of the systems in such a manner as they judge best calculated to answer the purpose of this inquiry—viz., which of these five systems of projectiles and four systems of rifling is to be preferred, and to determine whether any one of them is to be recommended for further trial or adoption.

23. The trial of steel shot or shells against iron defences, and of cast-iron common and segment shells, will be confined to the gun preferred as a shot gun.

Range Firing.

The following were the results at various degrees of elevation* :—

AT 5 DEG. ELEVATION.

Rifling.	Mean range. Yards.	Mean difference of range.	Mean reduced deflection.
French.....	2723	33·5	4·7
Scott	2834	35·7	3·6
Lancaster.....	2816	18·9	4·3
Jeffrey shot	2562	115·3	9·4
Britten shot.....	2516	63·6	10·4

AT 10 DEG. ELEVATION.

Rifling.	Mean range. Yards.	Mean difference of range.	Mean reduced deflection.
French.....	4489	40·2	10·8
Scott.....	4695	20·8	24·9
Lancaster.....	4487	17·0	4·5
Jeffrey shot	4340	51·8	12·7
Britten shot.....	3690	162·6	122·1

FIRING WITH 20LB. CHARGES.

Eleva- tion. Degs.	Rifling.	Mean range. Yards.	Mean difference of Range.	Mean Reduced Deflection.
10	French.....	4210	41·6	10·6
10	Scott.....	4444	63·8	28·2
10	Lancaster.....	4299	75·1	12·9
2	French	1386	35·4	0·6
2	Scott.....	1462	21·5	0·9
2	Lancaster.....	1455	27·3	1·9

* The means here given are those to which I have taken exception elsewhere as inaccurate.

FIRING WITH 25LB. CHARGES.

Elevation. Degr.	Rifling.	Mean range. Yards.	Mean difference of Range.	Mean Reduced Deflection.
2	Scott.....	1604.2	15.6	1.2
2	Lancaster.....	1589.8	28.8	2.0
2	Britten.....	1361.3	104.2	5.0
2	French.....	1499.8	52.4	2.0
10	Scott.....	4779.2	29.4	8.9
10	Lancaster.....	4605.0	26.6	6.6
10	French.....	4542.8	45.8	22.4

VELOCITIES.

WITH 12LB. CHARGES AT 10 DEG.

French	1256 feet per second.
Scott	1270 " "
Lancaster	1273 " "
Jeffrey shot	1280 " "
Britten shot	1290 " "

WITH 20LB. CHARGES AT 10 DEG.

French	1450 feet per second.
Scott	1490 " "
Lancaster	1485 " "
Jeffrey shot	1500 " "
Britten shot	1500 " "

WITH 25LB. CHARGES AT 10 DEG.

French	1550 feet per second.
Scott	1584 " "
Lancaster	1600 " "
Jeffrey shot	1590 " "
Britten shot	1571 " "

Impressions of the Bore.

After forty-five rounds from the French, forty-five rounds from the Scott, forty-five rounds from the Lancaster, and ninety rounds from the Jeffrey-Britten the impressions stood thus:—

Jeffrey-Britten	Worst.
French	Next.
Scott	Next.
Lancaster	Best.

The indentation in the Jeffrey-Britten was consider-

able, the indentation in the French and Scott was distinct, the indentation in the Lancaster was extremely slight. The indentation in all cases was just in advance of the extremity of the cartridge. To assist the judgment on this important point let me state that the Jeffrey-Britten is rifling with fifteen shallow grooves for lead-coated or expanding projectiles; the French is rifling with three deep grooves; the Scott is rifling with five less deep grooves; and the Lancaster is rifling without grooves—in other words, a smooth-bore oval rifle. It therefore appears to follow experimentally that indentation is in proportion to the number or depth of grooves, and that a gun without grooves is a better wearing gun than a gun with grooves. Of course that is obvious enough *a priori*; but *a priori* considerations are very properly excluded when matters are brought to an experimental issue. That all the guns should show more or less of wear after so few as forty-five rounds is a circumstance that scarcely bears out the steel-tube theory. Indeed, it is the case that steel tubing for guns of large calibre is only now on its trial; and to give proofs of weakness after forty-five rounds will go far to revive the drooping spirits of the advocates of wrought-iron.

The actual measurements of the indents in the barrels of the guns, as they stood after firing no more than 86 rounds, were—

MEASUREMENTS OF INDENTS, JULY 19..

French	In groove 15-100ths of an inch.
„	In lands 2-100ths of an inch.
Lancaster	In one part only 2-100ths of an inch.
Scott	In groove 3-100ths of an inch.
„	In lands 0.15-1000ths of an inch.
Britten	In groove 5-100ths of an inch.
„	In lands 2-100ths of an inch.

Thus the guns being all Armstrongs, and differing solely in their rifling, it appears that the French deep-groove rifling is the most destructive of all to the gun; the Britten fifteen shallow grooves the next; the Scott five shallow grooves the next; and the Lancaster smooth bore rifle the least. Nay more: only one spot of the Lancaster barrel is touched, while the damage to the other guns nearly extends round the bore.

The Scott Rifling. The results which follow were copied by me from the range tables, with the sanction of General Lefroy:—

THE SCOTT RIFLING.—10TH DAY'S FIRING.

Rounds.	Charge.	Elevation.	Range.	Deflections.	
				Right. Feet.	Left. Feet.
1	12lb.	5 deg.	2283	30	
2	"	"	2221		18
3	"	"	2251		1·5
4	"	"	2326		12
5	"	"	2187		1
6	"	"	2031		21·5
7	"	"	2164	12·5	
8	"	"	2120	12	
9	"	"	2236	9	
10	"	"	2192	6	
11	"	"	2671		3
12	"	"	2708	24	
13	"	"	2593	27	
14	"	"	2641	23·5	
15	"	"	2570	1·75	
16	"	"	2660	17·5	
17	"	"	2620	20·5	
18	"	"	2614	11·5	
19	"	"	2636	24	
20	"	"	2634	19	
21	25lb.	5 deg.	2813	69	
22	"	"	2698	36	

10TH DAY'S FIRING—(Continued).

Rounds.	Charge.	Elevation.	Range. Yards.	Deflection.	
				Right. Feet.	Left. Feet.
23	„			2731	 59
24	„			2940	 31
25	„			2846	 37
26	„			2847	 39
27	„			2754	 32
28	„			2798	 27
29	„			2808	 52
30	„			2689	 35

The Scott was 21 feet to the left of the line, so that 21 feet is to be added to the right deflections and 21 feet deducted from the left deflections.

THE FRENCH RIFLING.—10TH DAY'S FIRING.

Rounds.	Charge.	Elevation.	Range. Yards.	Deflection.	
				Right. Feet.	Left. Feet.
1	12lb.	 5 deg.	.....	2294	 61
2 .....	„	.....	.....	2368	 78
3 .....	„	.....	.....	2213	 67
4 .....	„	.....	.....	2309	 69
5 .....	„	.....	.....	2242	 72
6 .....	„	.....	.....	2146	 54
7 .....	„	.....	.....	2122	 60
8 .....	„	.....	.....	2032	 52
9 .....	„	.....	.....	2020	 32
10 .....	„	.....	.....	2138	 9
11 .....	„	.....	.....	2565	 59.5
12 .....	„	.....	.....	2532	 72
13 .....	„	.....	.....	2512	 82
14 .....	„	.....	.....	2561	 66
15 .....	„	.....	.....	2536	 80
16 .....	„	.....	.....	2510	 79
17 .....	„	.....	.....	2497	 75
18 .....	„	.....	.....	2552	 71
19 .....	„	.....	.....	2524	 54
20 .....	„	.....	.....	2588	 94
21	25lb.	 5 deg.	.....	2713	 75
22 .....	„	.....	.....	2673	 87

10TH DAY'S FIRING—(Continued).

Rounds.	Charge.	Elevation.	Range. Yards.	Deflection.	
				Right. Feet.	Left. Feet.
23	„	„	2720	80	
24	„	„	2768	81	
25	„	„	2636	92	
26	„	„	2745	93	
27	„	„	2755	105	
28	„	„	—	—	
29	„	„	—	—	
30	„	„	—	—	

The French was 19·5 feet to the right of the line, so that 19·5 feet is to be deducted from the right deflections.

THE LANCASTER RIFLING.—10TH DAY'S FIRING.

Rounds.	Charge.	Elevation.	Range. Yards.	Deflection.	
				Right. Feet.	Left. Feet.
1	12lb.	5 deg.	2149	68	
2	„	„	2274	46	
3	„	„	2228	40	
4	„	„	2240	30	
5	„	„	2170	23·5	
6	„	„	2124	31	
7	„	„	2274	43	
8	„	„	2408	25	
9	„	„	2283	16	
10	„	„	2205	11	
11	„	„	2671	14	
12	„	„	2671	54	
13	„	„	2637	79	
14	„	„	2606	42	
15	„	„	2614	30	
16	„	„	2649	28	
17	„	„	2638	47·5	
18	„	„	2648	31	
19	„	„	2616	29·5	
20	„	„	2649	20·5	
21	25lb.	5 deg.	2689	40	
22	„	„	2794·4	38	

10TH DAY'S FIRING—(Continued).

Rounds.	Charge.	Elevation.	Range. Yards.	Deflection.	
				Right. Feet.	Left. Feet.
23	„		 2810·4	 44	
24	„		 2754	 23	
25	„		 2769	 32	
26	„		 2737	 36	
27	„		 2787	 39	
28	„		 2804	 10	
29	„		 2826	 34·5	
30	„		 2865	 51	

The Lancaster was 37·5 feet to the left of the line, so that 37·5 feet is to be added to the right deflections.

THE SCOTT RIFLING—11TH DAY'S FIRING.

Rounds.	Charge.	Elevation.	Range. Yards.	Deflections.	
				Right. Yards.	Left. Yards.
1	20lb.	 5 deg.	 2546·4	 24	
2 .....	„	.....	..... 2589·4	 22	
3 .....	„	.....	..... 2551·6	 19·4	
4 .....	„	.....	..... 2589·8	 14·4	
5 .....	„	.....	..... 2608·2	 21·6	
6 .....	„	.....	..... 2605	 16	
7 .....	„	.....	..... 2579·6	 15	
8 .....	„	.....	..... 2625·4	 14	
9 .....	„	.....	..... 2555·2	 2·8	
10 .....	„	.....	..... 2968·8	 18·4	
11 .....	„	.....	..... 2615	 15·6	
12 .....	„	.....	..... 2559·8	 14	
13 .....	„	.....	..... 2641·8	 16·4	
14 .....	„	.....	..... 2644·4	 16·4	
15 .....	„	.....	..... 2563·2	 16·8	
16 .....	„	.....	..... 2664	 16	
17 .....	„	.....	..... 2557·6	 17	
18 .....	„	.....	..... 2710	 23·4	
19 .....	„	.....	..... 2711	 15·2	
20 .....	„	.....	..... 2635	 13·6	

The Scott was 7 yards to the left of the line, so that 7 yards is to be added to the right deflections.

THE FRENCH RIFLING—11TH DAY'S FIRING.

Rounds.	Charge.	Elevation.	Range. Yards.	Deflections.	
				Right. Yards.	Left. Yards.
1	20lb.	5 deg.	2475	30	
2	"	"	2504	38·2	
3	"	"	2438	19	
4	"	"	2297	25·2	
5	"	"	2328	21·6	
6	"	"	2372·4	27·2	
7	"	"	2423	30	
8	"	"	2417	25·2	
9	"	"	2339	41·2	
10	"	"	2459	25·4	
11	"	"	2373	25·6	
12	"	"	2421	32·2	
13	"	"	2486	40·2	
14	"	"	2410	22	
15	"	"	2410·6	39	
16	"	"	2440	46·6	
17	"	"	2528	35·6	
18	"	"	2534·4	44·6	
19	"	"	2516	24·6	
20	"	"	2445	29·4	

The French was 6·5 yards to the right of the line, so that 6·5 yards is to be deducted from the right deflections.

THE LANCASTER RIFLING—11TH DAY'S FIRING.

Rounds.	Charge.	Elevation.	Range. Yards.	Deflections.	
				Right. Yards.	Left. Yards.
1	20lb.	5 deg.	2335	36	
2	"	"	2554	23·4	
3	"	"	2504	19	
4	"	"	2500	16	
5	"	"	2545·6	20	
6	"	"	2460	19·4	
7	"	"	2597	18·2	
8	"	"	2555	14·6	
9	"	"	2573·8	21·8	
10	"	"	2570·2	18·2	
11	"	"	2609·2	24·8	

11TH DAY'S FIRING—(Continued).

Rounds.	Charge.	Elevation.	Range. Yards.	Deflection.	
				Right. Yards.	Left. Yards.
12	"	"	2637	33	
13	"	"	2592·4	30·6	
14	"	"	2530·6	26	
15	"	"	2574·6	19·2	
16	"	"	2609·2	16	
17	"	"	2548·8	35	
18	"	"	2581·2	31	
19	"	"	2579·4	31	
20	"	"	2602·4	20	

The Lancaster was 12·5 yards to the left of the line, so that 12·5 yards is to be added to the right deflections.

THE SCOTT RIFLING—12TH DAY'S FIRING.

Round.	Charge.	Elevation.	Range. Yards.	Deflection.	
				Left. Yards.	Right. Yards.
1	12lb.	2 deg.	1426	14	
2	"	"	1312	2	
3	"	"	1229		2·2
4	"	"	1450	3	
5	"	"	1127	4·2	
6	"	"	1328		9
7	"	"	1415	8	
8	"	"	1455	14	
9	"	"	1235	1	
10	"	"	1525	2	
11	20lb.	"	1345	6	
12	"	"	1353		1
13	"	"	1525	2	
14	"	"	1457		8
15	"	"	"		12

The Scott was 7·0 yards to the left of the line, so that 7·0 yards are to be added to the right deflections, and 7·0 yards are to be deducted from the left deflections. Round shot used; no wad; wet sponge; gun laid at targets 1,000 yards distance; wood bottoms attached to the shot, which had to be filed down.

THE FRENCH RIFLING—12TH DAY'S FIRING.

Round.	Charge.	Elevation.	Range. Yards.	Deflection.	
				Left. Yards.	Right. Yards.
1	12lb.	2 deg.	1296		14
2	"	"	1155		11·6
3	"	"	1242		5·4
4	"	"	1262		16
5	"	"	1160		3·2
6	"	"	1247	2·4	
7	"	"	1227		4·4
8	"	"	1454		8
9	"	"	1180		2·8
10	"	"	1250		16·4
11	20lb.	"	1357		14·4
12	"	"	1256		1
13	"	"	1442		4
14	"	"	1292		8·4
15	"	"	1411		14

The French was laid on the line. Round shot used; no wad; wet sponge; gun laid at targets 1,000 yards distance; wood bottoms attached to the shot which had to be filed down.

THE LANCASTER RIFLING—12TH DAY'S FIRING.

Round.	Charge.	Elevation.	Range. Yards.	Deflection.	
				Left. Yards.	Right. Yards.
1	12lb.	2 deg.	1025	10	
2	"	"	1206	10·4	
3	"	"	1186	4	
4	"	"	1052	19·8	
5	"	"	1101·4	9·8	
6	"	"	1246	14·6	
7	"	"	1145·2	2	
8	"	"	1200	9·6	
9	"	"	1129	7·6	
10	"	"	1179	0·4	
11	20lb.	"	1516	12·8	
12	"	"	1525	17	
13	"	"	1421		1
14	"	"	1209	22	
15	"	"	1296	11	

The Lancaster was 12·5 yards to the left of the line, so that 12·5 yards are to be added to the right deflections, and 12·5 yards deducted from the left deflections. Round shot used; no wad; wet sponge; gun laid at targets 1,000 yards distance; wood bottoms attached to the shot, which had to be filed down.

THE SCOTT RIFLING—13TH DAY'S FIRING.

Round.	Charge.	Elevation.	Range. Yards.	Deflection.	
				Right. Yards.	Left. Yards.
1	12lb.	5 deg.	1975	18·6	
2	"	"	2178	7·4	
3	"	"	2204	13·2	
4	"	"	2287	9·2	
5	"	"	2115	1·2	
6	"	"	2245	26	
7	"	"	1959		0·2
8	"	"	2025	35·4	
9	"	"	2189	39	
10	"	"	2225	23·4	

The Scott was 7 yards to the left of the line, so that 7 yards are to be added to the right deflections, and 7 yards deducted from the left deflections. Round shot loose; wad and grummet ring attached to the cartridge; wet sponge.

THE FRENCH—13TH DAY'S FIRING.

Round.	Charge.	Elevation.	Range. Yards.	Deflection.	
				Right. Yards.	Left. Yards.
1	12lb.	5 deg.	1973	—	0·4
2	"	"	2075	17·2	
3	"	"	2033	29·6	
4	"	"	1986	15·4	
5	"	"	1922	28·6	
6	"	"	2141	8	
7	"	"	2096	8	
8	"	"	2033	14·6	
9	"	"	1983	4·6	
10	"	"	2093	12·8	

The French was laid on the line. Round loose shot; wad and grummet ring attached to the cartridge; wet sponge.

THE LANCASTER RIFLING.—13TH DAY'S FIRING.

Round.	Charge.	Elevation.	Range. Yards.	Deflection.	
				Right. Yards.	Left. Yards.
1	12lb.	5 deg.	1964 .....	.....	0·5
2	„	„	1853	 5·8	
3	„	„	2007·4 .....	.....	3
4	„	„	2108 .....	.....	17·2
5	„	„	2020 .....	.....	21·8
6	„	„	1904 .....	.....	6·6
7	„	„	2028	 0·4	
8	„	„	1870	 11·4	
9	„	„	1861	 6·6	
10	„	„	1942	 , 8	

The Lancaster was 12·5 yards to the left of the line, so that 12·5 yards are to be added to the right deflections, and 12·5 yards deducted from the left deflections. Round shot loose; wad and grummet ring attached to the cartridge; wet sponge.

CHAPTER XII.

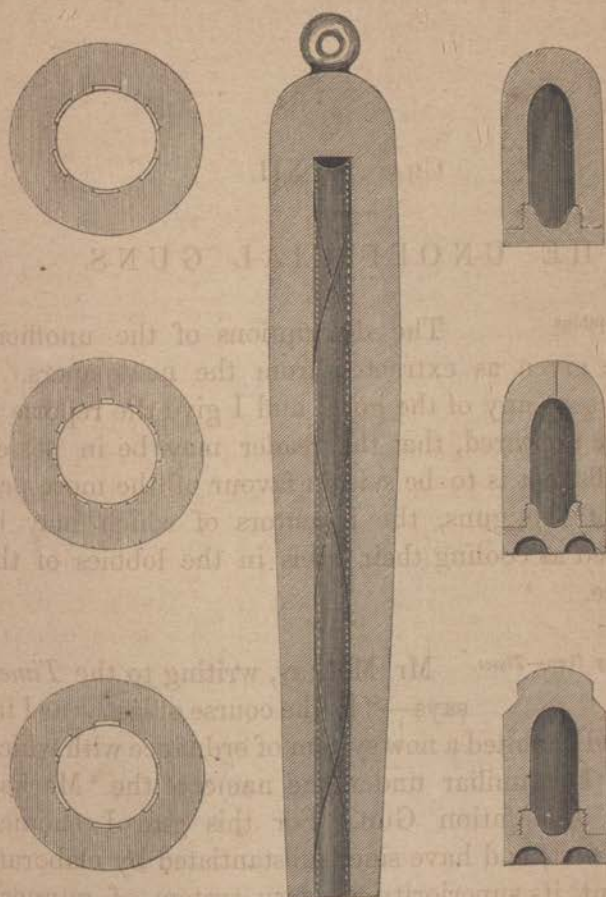
THE UNOFFICIAL GUNS.

The Descriptions.

The descriptions of the unofficial guns are given as extracted from the newspapers. I have not seen any of the guns, and I give the reports as they have appeared, that the reader may be in possession of all that is to be said in favour of the more prominent of the guns, the inventors of which may be represented as cooling their heels in the lobbies of the War-office.

The Mackay Gun—*Times*,
Dec., 1864.

Mr. Mackay, writing to the *Times*, says—"In the course of last year I invented and patented a new system of ordnance with which you will be familiar under the name of the 'Mackay Windage Adaptation Gun.' For this gun I claimed from the first, and have since substantiated by elaborate experiment, its superiority to every system of gunnery extant. I take it that an inventor of things which can only be used by the nation and bought with the public money is bound to test publicly his invention to a reasonable and satisfactory extent, and to show that he can do what he professes. If he does this he establishes reason-



VARIOUS CALIBRES OF MACKAY RIFLING, GUN, AND PROJECTILES.

able ground for asking the nation to take up the patent, and to indemnify him for his labour and expenses. This I have done. I have made the gun, and I have shown that it can do what I claim for it, and I now maintain that Government is in fairness bound to test the weapon in a fair and equitable manner, and then if it is found to meet—as I say it does—the desideratum for which they have spent so much money, I am, I think, entitled to some consideration at their hands. In dealing with the question of gunnery, my object could only have been with the ultimate view, in case of my success, of Government taking up the invention. I knew they wanted a gun, and I said they had not got it. I spent time and money in endeavouring to supply the want, and I succeeded. Therefore I now feel, and I think you and your readers will here bear me out, that I am entitled to a fair and reasonable test of my invention (with a view, in case of its success, to adoption) at the public expense. It is needless for me here to describe my invention: that has already been done repeatedly; but I may say that the range of my gun, the velocity of my projectiles, the accuracy of my gun, and the durability of my gun are infinitely superior to any other. Did I speak from mere theory I might be supposed to be slightly infatuated, but I speak from facts. The steel shot from my 8-inch gun, with a charge of 30lb. of powder, was propelled five times in succession through the Agincourt target, $5\frac{1}{2}$ -inch best armour-plate, 9-inch teak, and 1-inch skin, and one shot was picked up more than 1,400 yards beyond the target. The distance was the regulation one of 200 yards, but I am confident that the effect would have been the same at 500 yards, and even more. Therefore, I think the velocity and penetrating power of my gun are beyond question. My 12-pounder gun has at 25 degrees

elevation sent every shot over 6,000 yards, and some beyond 7,000, according to the length of the projectile used. This is far beyond the utmost range of either the Armstrong or Whitworth guns of the same calibre. The shot spin perfectly, and there is not the slightest 'hobble,' which is the characteristic of rifle guns. The accuracy of the gun is most decided. I have fired at a target 20ft. high by 8ft. wide, and distant 1,000 yards, till I was tired, and hit it every time. Finally, the gun is quite uninjured by any reasonable service. I have one from which I have now fired upwards of 500 rounds, and every groove, nay, every tool-mark, is as perfect to all appearance as the day it left the manufacturer's hands. These are simple facts. Surely they tell their own tale. Have I not made out a case which is worthy of some attention? Government has already spent three millions and probably nearly four millions of money in the search after, and the production of, a gun, which, I respectfully submit, is for all practical purposes, useless, simply because it will not stand to its work. My gun beats it in all material points; yet hitherto, in spite of repeated applications, I have been refused a trial upon anything approaching fair and reasonable terms. My correspondence with the War-office is too lengthy to permit any detailed reference to it here, but you may, perhaps, permit a brief allusion to one point. A short time ago I offered to make 20,000 12-pounder projectiles on my principle at the price allowed to Mr. Whitworth for projectiles, and to place the 12-pounder Mackay gun in competition with any gun whatever, having interior arrangements, upon any other system, and to continue the firing until the whole 20,000 rounds were expended, the Secretary of State for War to bear all the expenses connected with the trial; but should the gun become

destroyed or burst during the firing, no charge to be made by me for the gun. To this offer I received a reply, stating that, as the only object to be gained in firing so large a number of projectiles would be the test of the endurance of the piece, his lordship must decline to accede to my proposal, it being deemed of no advantage to the Department to ascertain the enduring qualities of so small a gun. This throws a new light on the subject for which I was unprepared. The 12-pounder gun is still in the service, and I always thought it to be an axiom of warfare that men should be shielded from injury by their own weapons. Again, while the guns are in use durability saves renewal and the public money; and yet again it may be fairly concluded that if my gun, on a small scale, is so remarkably durable, it will, in like ratio, be durable on a large scale. So much for that remarkably untenable objection. But the matter did not end here. I wrote back to say that I desired the test to embrace not only the durability, but range, accuracy, and every other quality of the gun. To this letter Lord de Grey and Ripon ordered a reply, stating 'that he sees no reason to alter his decision.' As this 12-pounder gun was offered at the request of a member of the Ordnance Committee, and subsequently by his lordship himself, I submit, with all respect, that there is no reason why my just claims should be so systematically ignored; and I have only to say, in conclusion, after apologising for the length of my letter, that I have now passed several months of useless and profitless correspondence with the War-office, and, although a feeling of patriotism has hitherto prevented my seeking customers elsewhere, I trust that the British public will now hold me blameless, if at some future day the 'Mackay gun' shall carry ruin and destruction into the armaments of

Old England, when she, if she remains content with the weapons she at present has, will be utterly powerless to answer them."

The Mackay Gun—Times,
3d January, 1865.

Mr. Mackay, again addressing the *Times*, says — "On Friday last I tested my new 7-inch gun on the shore at Crosby, near Liverpool. Two shots, weighing 124lb. each, were fired with 20lb. of powder. The first shot at 10 deg. elevation made its first graze at 4,252 yards; and the second at $13\frac{3}{4}$ deg. reached 4,700 yards before grazing. This result will, I think, compare favourably with the achievements of any other weapon or calibre."

Writing once more to the *Times* he says—"On Saturday, the 7th instant, I fired a shot 14 inches long and weighing 116lb., with 20lb. of powder, from the 7-inch 'Mackay' gun, at 25 deg. elevation. The shot was found buried in the sand (first graze) at a distance of 7,153 yards from the gun."

The Hutchinson Gun—
Times, 4th October, 1864.

"A gun, we believe, of entirely novel construction has been invented and patented by Major-General Hutchinson, commanding in the west of England, and if the expectations of the inventor be only partially realised, great changes will take place in the construction of much of our ordnance. The objects sought to be accomplished in the new gun are—first, that it shall weigh little more than 20 times, instead of upwards of 800 times, the weight of the shot, as is usual; secondly, that without friction it shall impart rapid rotation to the shot; thirdly, that the shot shall be of the form best adapted for penetrating the air and target; and lastly, that it shall leave no vacuum behind it, and not ricochet when it strikes the water.

A few experiments have been made at Plymouth. The last took place on the 28th ult., on board the gunnery ship 'Cambridge,' Captain J. F. Ewart, in Hemoaze. The gun is somewhat like a lengthened mortar. The chamber is of the usual cylindrical form, but only sufficiently long to hold the powder and wadding. It is at the mouth that the chief peculiarity occurs. The shot is termed disc shot. Those used last week were about the size of two very small plates placed against each other, excepting that the edge is sharp. The muzzle of the gun is much enlarged, and is formed so as to receive with great exactness the inner half of the disc shot. The more accurate the fitting is the less the escape of gas and the truer the aim that can be taken. When in place the outer edge of the shot is flush with the muzzle of the gun. The shots weighed 4lb. 2oz. The charge of powder, 6oz., being 1-11th part of the weight of the shot, whereas the usual proportion is about one-fourth the weight of the shot. The gun was of nearly 200lb. weight, double, the inventor said, what it ought to have been. The first trial was at the 1,000 yards' target. The shot went in a good direction, and pitched 100 yards beyond the mark. The other two experiments were at 13 deg. elevation for range, and 4 deg. for aim. In neither case could the position of the shot, when they fell, be observed. The tide was out, and doubtless on striking they, from their rotation, buried themselves in the mud. The experiments, as far as they went, were considered satisfactory. When in the gun the shot stands in a vertical position, and rotation is caused by the axis of the chamber lying above the centre of the shot, and by a small projection in the interior of the muzzle, at the bottom, meeting the edge of the shot. From the shortness of the gun it possesses

all the advantages of a breech-loader, and from the simplicity of its construction and the little metal used it promises to be both a cheap and easily handled weapon. The projector may be too sanguine, but he avers that one weighing no more than the ordinary 68-pounder will discharge a 600lb. disc. The carriage is fitted with a number of galvanised indiarubber cylindrical buffers (in contact by their sides, not extremities), placed in grooves on the flanks of the gun; these received the recoil. By a simple mechanical arrangement the rebound was received in a similar manner on a series of rings fixed below the gun. The disposition of india-rubber rings the inventor prefers to any compressors, as they do not make the gun 'jump,' to use the technical expression."

The Squire's Gun—Standard, "A little incident which occurred
10th May, 1864.

yesterday is an indication of the popular sympathy for the brave Danes in their unequal struggle with the German powers. A field piece, forming part of a battery of 14 guns, mounted on its carriage and limbered, was drawn through the streets of London from the Nine Elms Station to Mr. Squire's gun-factory in Whitechapel, to be rifled on a new principle which is calculated to impart greater initial velocity to projectiles than hitherto has been obtained with rifled cannon.

"The 'story of the guns' of this field battery is not without interest. Mr. Waterman, of Shirley, near Southampton, an amateur artilleryman, had them constructed at his own expense for the purpose of firing salutes on festive occasions, with the ulterior view of presenting them to an artillery Volunteer corps.

"On the breaking out of the Germano-Danish war Mr.

Waterman took so warm an interest in the cause of the Danes that he determined to offer his battery as a gift to the King of Denmark, and he wrote to Lord Palmerston asking whether there would be any objection to his carrying his design into effect. The Premier, having courteously replied that he saw no impropriety in the proposal, Mr. Waterman applied to the Prince of Wales, through General Knollys, requesting his Royal Highness to transmit the offer to the Court of Denmark, and he received a letter from the General to the effect that the Prince, duly appreciating the motives which prompted this generous offer, had directed it to be forwarded to Copenhagen through the proper channel.

"The answer of the Danish King has not yet been received. In the meantime, in order to render the presentation of a field battery more acceptable to the Danes in their unequal contest with old-fashioned smooth-bores against the murderous Prussian rifled artillery, arrangements have been made with the inventor of the new system referred to to rifle the battery on his plan. The essential principle of the plan is to produce rotary motion in the projectile without causing more strain on the gun than that of spherical shot fired from a smooth-bore. Encountering no resistance but its own *vis inertia*, and travelling by gravitation along spiral grooves in the lower half of the bore without contact at the upper half, the projectile is propelled with the full power of the explosive gas.

"From experiments made with much success, it may be inferred that the initial velocity resulting from this system will greatly surpass that of any of the existing modes of rifling, all of which, either by compression or expansion of metal coating or studs, or by mechanical fit, cause so much friction, and put so heavy a strain on

the gun that the usual effect of the charge is greatly reduced, and the piece is rapidly deteriorated.

“It is a fact established by the Ordnance experiments of the last three or four years, and corroborated by the trials of the Armstrong and Whitworth guns now going on at Shoeburyness, that the greatest available velocity imparted by rifled guns is 1,200 to 1,300 feet per second. The initial velocity obtained with cast-iron smooth-bores is 1,500 to 1,600 feet per second with the ordinary service charge and great windage. With wrought-iron or steel guns capable of bearing heavier charges, and fired with reduced windage, initial velocity exceeding 2,000 feet may be obtained. When it is considered that the force of a projectile is in proportion to the square of the velocity, the immense value of any increase in the element of propelling power will be understood. The squares of 2,000 and 1,200 would give 400 and 144 as the figures representing respectively the force of those two velocities, one being nearly three times greater than the other. Hence the value of the gravitating principle of rifling, if the anticipations of the inventor are realised, will be appreciated.

“If Mr. Waterman’s gift should have the effect of introducing into the Danish service a system of rifled artillery superior to that of any other nation, he will not only obtain the credit he is entitled to for his spirited liberality, but he will render an important service to the Danish cause.”

The Palliser Guns.*—
Times, Jan. 3, 1865.

“The 68-pounder cast-iron gun,
converted by Major Palliser into a

* Major Palliser has conducted a series of very interesting experiments with his lined guns, which go to show that guns are not so liable to destruction from charges of

7-inch 100-pounder rifled gun of five tons weight, has just been returned from Shoeburyness to Woolwich, having fired 100 rounds down the range at the former place. The charges employed were 12lb., 16lb., and 20lb. of powder. The shot, in order to obtain comparable results, were made of the same form and weight as those employed in the 7-inch wrought-iron guns of 7½ tons weight, which are rifled on the Scott, Lancaster, and the French principles. The mean ranges were—

Elevation.	Charge of powder.	Yards.
5 deg.	12lb.	2480
5 „	16 „	2567
5 „	20 „	2752
2 „	16 „	1330
10 „	16 „	4222

The gun is rifled with three grooves, and for some distance from the breech end the spiral is accelerated, in order that the shot may receive the necessary spin by degrees; towards the muzzle, however, the spiral gradually becomes 'uniform'—that is to say, similar to that of ordinary rifling. The shot have each six metal studs screwed into them, three large ones in the rear and three small ones in front. On being fired the shot is at starting turned by the large studs alone, but as it approaches that part of the bore where the rifling becomes uniform, the small studs in front gradually take up the rifling also, and thus the shot is steadied by all six studs before it leaves the gun. The gun which had fired 140 rounds quite satisfactorily has been handed over to Major Freeth, the Inspector of Artillery at Woolwich, in order to complete its test of 1,000 rounds

powder as from weight of shot. The charge of powder may with safety be indefinitely increased if a corresponding reduction is made in the weight of the shot to be fired. The idea is not new—it is French, the French having obtained great penetration with light guns by that means.

as quickly as possible, as the result will be of great importance. The firing was yesterday renewed at the proof butt at Woolwich with charges of 16lb. of powder and shot weighing 100lb. The proof confirms the belief that the invention of Major Palliser will prove most beneficial in utilising the enormous stock of waste guns so as to render them profitable for the service."

THE TARGETS.

CHAPTER XIII.

EXPERIMENTS PRIOR TO 1861.

Earliest Artillery Targets—
The Spanish.

The earliest artillery targets were an improvisation of the Spaniards at the combined French and Spanish attack on Gibraltar in 1782. Ten of the Spanish ships were converted into batteries by a ready application of neighbouring Spanish products. The sides of the ships received a 7-foot casing of green timber, raw hides, and junk, and the decks an angular casing of the same material, for the deflection of shot and shell. That is eighty-three years ago, and most people I daresay will be disposed to think that modern invention has not yet carried us any respectable distance in advance of the junk, raw hide, and green timber period.

The American.

The illustrious Robert Fulton takes precedence after Spain. During the war of 1812 be-

tween England and the United States, the mind of that great man was occupied with the very questions which only within the past year or two have attained importance. Fulton planned floating batteries and submarine vessels, and in 1814 some of those inventions were secured by patent. His Demologos was the first battery ever built; and against the tide it maintained a steam speed of $2\frac{1}{2}$ knots an hour. That is half a century ago; and yet the English and French batteries constructed during the Russian war scarcely made 4 knots an hour against the tide. Crossing the Hudson river in an open boat, a cold then contracted robbed the world of one who might have carried ship-of-war construction beyond its present stage of incompleteness before the fathers of the generation of living naval architects and constructors became Benedicts. The war ended before the Demologos was launched; but until 1829 the Demologos was the receiving-ship at Brooklyn Dockyard. An accidental blowing-up brought the ship to a more worthy end than the breaker's yard. Mr. John Stevens, of New Jersey, shared the sentiments and possessed much of the genius of Robert Fulton. At a later period, General Totten conducted elaborate experiments.

The French.

France followed America, in the person of General Henri Joseph Paixhans, who was born at Metz so long ago as January, 1783. He foresaw the use of iron—although our own authorities do not seem to know its uses yet—and states that Gustavus Adolphus proposed fortification with blocks of iron; and that the Spaniards lamented the want of iron sides in the attack on Gibraltar. M. Montgéry, another Frenchman, published several memoirs on the subject many years ago. Last of all, as is well known, the Emperor of the French

assuming the initiative of application, ordered the construction of the batteries which attacked Kinburn in 1855.

Ourselves, 1801.

In 1801 an ineffectual attempt was made to protect the ships which took part in the battle of Algeiras. That settled the question for six-and-twenty years; it having been revived in 1827. So is it always with us; and so it will remain until we as a nation cease to see perfectibility in each successive phase of our development. When we come to accept things provisionally, and breathe the spirit rather than lisp the words of progress, national conceit will cease to be the stumbling-block that it is. After the failure of protection at Algeiras, the authorities may be conceived of boasting of the glorious wooden walls which had braved the battle and the breeze; implying that

To gild refined gold, to paint the lily,
To throw a perfume on the violet,
To smooth the ice, or add another hue
Unto the rainbow, or with taper light
To seek the beauteous eye of heaven to garnish,
Is wasteful and ridiculous excess.

At present, when our service guns burn no more than 16lb. of powder, while the service guns of the United States navy burn 100lb. of powder, we are told that the country was never so powerful, never so ready to draw the sword. The statement is only true in the partial sense, that it is so in a comparison of England with itself at different periods. But I fearlessly challenge contradiction to the fact that the England of to-day, in comparison with the United States, France, or Russia, was never more weak and impotent. Those nations are doing all they can at home for the consolidation of their

power on sea and land ; and some of them are laying the resources of this country under heavy contribution. We, on the contrary, have not a larger gun in position on the Thames, nor on our coasts, nor on the coasts of our possessions, than the Armstrong 110-pounder—a gun completely destructive of wood ships at moderate ranges, but perfectly powerless against the ironclads of any nation. Then as to ships: against each of our ironclads the United States could place half a-dozen Monitors; half-a-dozen ships with 15-inch or 20-inch guns, against our single ships with 8-inch guns. If the answer is that ships and guns could be soon produced, I have only to say that hitherto the building of ironclads has been a slow process on both sides of the Atlantic, and that the manufacture of the only 600-pounder gun that we have occupied very nearly a whole year.

General Ford's Experiments,
1827.

The experiments of Major-General Ford, R.E., on the Woolwich marshes in 1827, were a concession to those Englishmen who were not so satisfied with things as they were as the authorities. The General desired to demonstrate that even the year 1827 was one of an iron age. He was to show that the defence had it; that heavy siege guns were powerless against iron-faced works at moderate ranges. He erected a wall of huge Aberdeen granite blocks, and faced the blocks with two layers of iron bars—the one horizontal, the bars of which were $1\frac{1}{4}$ -inch square; and the other vertical, the bars of which were $1\frac{1}{2}$ -inch square. The authorities were in attendance, and the nation was on the tip-toe of expectation. Poor man, he had too great faith in iron, and was doomed to disappointment. The battery of 24-pounders opened on the iron-faced granite at 634 yards, and twenty single

rounds broke and stripped nineteen of the front layer bars and five of the inner. The Aberdeen granite, moreover, was completely pulverised, the iron having been cramped into the granite. The British Lion roared tremendously. General Ford was weak in the head and knees. How could he have thought of such a thing. His eyes would now convince him that the authorities had been most indulgent—indeed, too indulgent—to him, and there was no saying but most awkward questions might be asked in Parliament in consequence of the indulgence. It has been said that the Duke of Wellington was General Ford's only comforter. The Duke had experienced official sneers himself, and, although astonished at the power of the 24-pounders, none knew better than he the shortsightedness of the course the authorities were determined on pursuing. The authorities determined on the spot to set their faces against the iron age, and for many a long day in all circles the pulverising of the Aberdeen granite was the burden of after-dinner speeches in response to the toast of "the Army and the Navy."

The Colquhoun and Sandham Thin Plates, 1846.

From 1827 to 1846 there is an interval of nineteen years, and during those years English ordnance enjoyed repose. It was as perfect as human ingenuity could render it; it had done good service; and if the occasion arose it would again render as good service. For a great country like England to be made over to theorists, adventurers, and others in so essential a matter as its artillery was a proposition to be scouted, and accordingly it was scouted. But perfect unanimity did not prevail. The believers in iron were not all converts, and their cause was gradually strengthened by the reported experiments

of other countries. At length the authorities gave way; came down from the exalted position on which they had perched themselves after General Ford's failure. They confessed their error with the usual grace which enters into official penitence. Woolwich was ordered to give iron another trial, the day was fixed, and the authorities were on the ground. The target to be fired at was an oak one 4 feet thick, faced with 5-8-inch boiler plates, and the guns were 32-pounders. A good many rounds were fired, and the shot with two exceptions breaking up, only two penetrations were obtained. One of the shot struck where a previous one had done some injury, and passed through the boiler plate and the oak. A second shot fired with a higher charge passed through the boiler plate and broke up in the oak, effecting a maximum penetration of 3 feet. The authorities were once more in high glee. Iron was again beaten, and this time under the disadvantage of oblique firing: the shot, which completely penetrated, striking at an angle of 30 deg. Colonel Colquhoun, R.A., and Major-Gen. Sandham, R.E., were congratulated on the invincibility of the guns. The authorities once more boasted of their concessions to foreign innovations and scientific clamour. Her Majesty's service was perfectly safe in their hands, and "Rule Britannia" a very proper national anthem.

Woolwich 4-inch plates, 1856. There was another interval of

repose of ten years, from 1846 to 1856, broken only by two navy experiments for the Admiralty at Portsmouth. The first of those experiments in 1850 were on a target, representing a cross section of the Simoon, in one instance without oak and fir planking, and in another instance with oak and fir planking. In other words, 5-8-inch plates were fired

at with 32-pound shot, 8-inch hollow shot, and 10-inch hollow shot; and plank-supported 5-8-inch plates were subjected to the same ordeal. The results were overwhelming. As easily as an avalanche obliterates the footprints of an Alpine traveller, as comfortably as a policeman takes a small boy in charge, the points of impact on the cross section of the Simoon were reduced to pulp. The British Lion again roared tremendously. The guns were guns, and no mistake: and how could the Admiralty be expected to countenance so contemptible an innovation. The Admiralty would do nothing of the kind. Other nations might do as they liked, but the safety of the Empire on which the sun never sets was a sacred trust that admitted of no trifling.

The second of the Admiralty experiments took place at Portsmouth in 1854. It followed the other so closely because the Admiralty had been warmly pressed on the subject; the absurdity of deciding against iron with no thicker plates than 5-8-inch being too much for non-official people. The Admiralty, bending before the non-official storm, submitted a most respectable target to the heaviest service guns. The plates were $4\frac{1}{2}$ inches thick, with 4 inches of fir backing, strongly screw-bolted to a well braced and strutted timber frame. Ten rounds were fired from a 32-pounder at 360 yards, all striking the plates. One shot produced an indentation of 2 inches; two in nearly the same place an indentation of $2\frac{1}{4}$ inches, slightly cracking the plate besides; and four cracked a plate in as many places, and bulged it $3\frac{1}{2}$ inches. All the shot were broken up. Two 68-pounder shot, with 16lb. charges, produced $1\frac{1}{2}$ -inch indentations at 1,250 yards; ten of the same shot, with 13lb. charges, at 400 yards, produced indentations of $2\frac{1}{2}$ inches; and one of the same shot, with a 16lb. charge, at 400 yards shattered

plates and backing. These were new laurels for the guns, earned, however, in consequence of the inexperience in armour plate making. The Admiralty, in claiming the victory, betrayed a marvellous want of judgment. They decided that one armour plate is as good as another, and that the infancy of a manufacture is as perfect as when experience has eliminated error and matured detail. A sounder judgment would have proved of incalculable benefit in respect to prestige, and of great advantage in respect to outlay. The blunder led to much of the unwise expenditure, from which the public service at this moment suffers.

The Woolwich Plates.

As remarked before, there was another interval of ten years—from 1846 to 1856—between the experiments at Woolwich. The 1856 plates were experimented on at the instance of Sir John Burgoyne, who was desirous of getting better covered guns in fortifications. The plates ordered from various makers were 4 inches thick, backed by 2 feet of timber. The guns employed on the occasion were 68-pounders, and the indentations varied with the quality of the plates, the minimum at 600 yards being 1 inch, and the maximum 3 inches. The plates were also more or less cracked. A wrought-iron shot, at 400 yards, gave an indentation of 3 inches without cracking the plates. At the close of the firing the plates and woodwork were in an extremely shattered state; the woodwork separated, and driven back 3 or 4 feet.

There were further experiments to ascertain what thickness of iron solid and hollow cast-iron shot would pass through, without breaking, and the results were—that solid and hollow shot would pass through $\frac{1}{4}$ -inch and 3-8-inch plates without breaking; that hollow

shot would break up in passing through $\frac{1}{2}$ -inch plates; and that solid shot would break up in passing through 5-8-inch plates.

The important point in the experiments is that they originated with the officers of the Royal Engineers. The Engineer officers were, therefore, leaving the authorities behind. But the authorities have since proved too much for the Engineers, nine years having passed without Sir John Burgoyne's views in respect to iron being carried out.

Woolwich, 1857.

The following year—namely, 1857, there were additional experiments with huge cast-iron blocks and 4-inch and 2-inch plates. The 2-inch plate was steel (Mr Begbie's), the 4-inch plates as before were supplied by various makers. Both were formed into targets, with 2 feet of oak behind, and the guns 68-pounders. The effects were, that at 600 yards cast-iron shot were resisted, while wrought-iron shot passed through the targets. The steel plate fared little better than the wrought-iron plates, and at 400 yards the plates were destroyed by both cast and wrought shot. The cast-iron blocks weighed 8 tons each, and measured 8 by 2 by $2\frac{1}{2}$ feet, and they were tongued and grooved together with rear supports of granite. They, it was supposed, would form a cheap substitute for the wrought-iron plates, and experiment could only show whether they would successfully resist shot. They were a complete failure; the 68-pounder at 400 yards, with the 16lb. service charge, creating indentations which varied from 1.3 to 1.9 inches, and breaking off splinters which weighed from 10 to 80 lb. The experiments with those and other cast-iron blocks of greater weight may be said to have opened the official door to the

outside world. After listening to representations about cast-iron blocks, it was understood that the authorities would consider any proposition. From the extravagance of incredulity in regard to iron they passed to the extreme of credulity; abandoning themselves to haphazard schemes, in the hope of hitting the right thing sometime.

Woolwich, 1858.

Only one experiment took place at Woolwich in 1858—that of a wrought-iron plate 8 inches thick, and weighing 5 tons. It was raised on its edge at an angle of 10 deg., and supported behind by fragments of the cast-iron blocks, and by heavy granite blocks. Fire opened from the 68-pounder, with 16lb. charges, at 400 and 600 yards. The cast-iron indentations were 1.25 inch, with slight cracks. At 400 yards the cracks were extended, and at 600 yards, with wrought-iron shot, large pieces of the plate broke off with each round.

Portsmouth, 1858.

During the same year the Admiralty, now fully alive to the danger of France being the sole possessor of ironclads, conducted various experiments at Portsmouth. The first experiment was to set at rest two vexed questions which, at the time, were warmly canvassed—namely, the comparative effects of 68 and 32 pounders at close quarters; and the penetrating power of shell, red-hot shot, and hollow shot also at close quarters. For the experiments 4-inch wrought-iron plates were attached to a ship's side, and it was found that at 100 yards five 32-pound shot striking close together did less execution on the armour, and much less on the woodwork, of the ship than one 68lb. shot. It was also found that at 20 yards the 68-pounder cast-

iron shot, with the ordinary 16lb. service charge, did not penetrate the armour, while a 72lb. wrought-iron shot, with the same charge, merely penetrated. Shell, hollow shot, and red-hot shot made very little impression on the 4-inch plates at 400 or 200 yards; and cast-iron shot did very little more damage at 20 than at 100 yards.

Mr. Whitworth made his first appearance in the autumn of this year with a 68-pounder, which, it is said, burst after passing a wrought-iron shot through a 4-inch plate and 7 inches of oak at 450 yards. •

This year also the question of the deadly splinters from iron ships was revived with great acrimony, and the wood-frame Meteor and iron-frame Erebus—floating batteries—were got in readiness for the solution. The occasion among naval officers especially was one of intense interest; and although the results were long and stoutly maintained to confirm two contradictory theories, it is the case that the opponents of iron ships, on the ground of splinters, have all since either died off or become converts. Some of those who resisted iron ships on that ground with much pertinacity have been of late years numbered among the detractors of their previous theory. The Meteor's side presented an inner oak planking from 4 to 9 inches thick, 10-inch oak timbers 4 inches apart, 6-inch outside oak planking and overall 4-inch wrought-iron plates. This structure resisted a wrought-iron 68-pounder shot at 400 yards, and at 300 yards suffered very little inboard injury. The Erebus' side presented 5-8-inch inside iron skin on iron ribs 5 or 6 inch oak plank, and overall 4-inch wrought-iron plates. The 68lb. shot penetrated the side of the Erebus, and the inboard damage was very serious from the iron splinters: so serious that few of those between decks would have escaped injury.

Portsmouth, 1859.

Next year experiments were resumed at Portsmouth, and the Iron Plate Committee began their labours at Shoeburyness. The first Portsmouth target was the Thorneycroft; tongued and grooved wrought-iron bars 14 inches thick, resting on each other like a wall. Captain Wrottesley, R.E., and Sir John Burgoyne, were the promoters of the iron wall; and it received the fire of the 68-pounder at 400 yards without serious damage, unless where the vertical bolts passed through the centre of the bars. Some of the bars may still be seen at the iron store of Messrs. Thorneycroft and Co., Dyers' Hall Pier, Lower Thames-street.

Sir William Armstrong now entered an appearance with an 80-pounder against the Trusty. The sides of the Trusty presented 2 feet 1 inch of solid oak, faced with 4-inch armour plates, and various forms and qualities of shot were fired at different ranges. There was also the point of oblique firing to be settled, and the result was that much the same injury arose from direct firing, and from firing at an angle of 50 deg. A cast-iron flat-headed shot broke the plates, but did not penetrate them at 400 yards. A homogeneous iron shot penetrated plate and oak; the same shot fired with a reduced charge did not penetrate, but made a large fracture. A cast-iron conical-headed shot, weighing 100lb., failed to penetrate at 200 yards. The bolts stood fire well, unless when fairly hit.

The 80-pounder was next laid against 4½-inch plates of the Messrs. Palmer and 2-inch plates from the Mersey Iron Works, bolted to a section of a frigate, with homogeneous iron bolts and double nuts. The 2-inch plates were penetrated by shell at 400 yards, but the shell broke up. At the same range the shell of the 68-pounder broke the 2-inch plate without much injury to the

timber. A flat-headed homogeneous shot punched a hole through the $4\frac{1}{2}$ -inch plates, and by continued firing portions of the plate were driven 20 inches into the timber.

Further experiments followed with the 68-pounder, for the settlement of another naval difficulty; it having been maintained that by constant hammering at 200 yards armour plates might be driven off, or through a ship's side with cast iron shot. The opinion was not confirmed but negatived, by firing at $4\frac{1}{2}$ -inch plates.

Shoeburyness, 1859.

The Shoeburyness experiments of 1859 were conducted to determine the thickness of armour through which Armstrong shell and 68-pounder shell would pass, and $1\frac{1}{2}$, 2, $2\frac{1}{2}$, and 3-inch plates were bolted to the section of a fifty-gun frigate's side, the oak being from 18 to 24 inches thick. The 8-inch 68-pounder shell made a circular crack in a $2\frac{1}{2}$ -inch plate, and two 78lb. Armstrong shells, with 10lb. charges, passed through a 3-inch plate, but not through the timber.

Portsmouth, 1860.

The Portsmouth experiments of 1860 were to try Jones's angular target, and the relative penetration of elongated shot and balls. At 200 yards it was found that two shot striking with the same velocity, the one round and the other elongated, the effects were greater spread and smashing in the case of the round shot, and greater penetration in the case of the elongated shot. Further, that a round shot spreads on punching, and is opposed by a large surface; while a flat-headed shot has no spread, and is opposed by a small surface.

The angular target was formed of $\frac{1}{2}$ -inch rib plates, 21 inches deep and 14 inches apart, with $13\frac{1}{2}$ inches of

fir planking and the armour plates. The target stood at an angle of 52 deg. The plates were $4\frac{1}{2}$ -inch wrought iron and $3\frac{1}{2}$ inches steel, from the Mersey Iron Works, and $4\frac{1}{2}$ -inch Derbyshire iron. The Derbyshire iron was very brittle, and the steel plates a failure; but one of the Mersey Iron Works plates received 17 shot on an area of 13 square feet without being penetrated, or the wood-work much injured. The firing was at 200 yards from the 68-pounder, with 16lb. charges and cast-iron shot.

Shoeburyness, 1860.

The Shoeburyness experiments of 1860 were confined to iron shields for casemates, and to the elementary labours of the Iron Plate Committee. The committee invited all manufacturers to send in plates for experiment, and consulted practical and scientific men at home and abroad on the manufacture of iron. Almost every variety of plate was tried—including copper plates—from $\frac{1}{4}$ -inch thick upwards. A breech-loading wall-piece discharging a $5\frac{1}{2}$ oz. ball with an initial velocity of 1,100 feet per second, was used against all thicknesses up to 1 inch. A 6-pounder Armstrong, throwing cylindrical cast-iron shot at a velocity of 1,125 feet, did not penetrate $1\frac{1}{2}$ -inch plates at 50 yards; a 12-pounder Armstrong, throwing the same form of shot at a velocity of 1,150 feet, did not penetrate 2-inch plates at 100 yards; a 25-pounder Armstrong, throwing the same form of shot, did not penetrate $2\frac{1}{2}$ -inch plates at 100 yards; and a 40-pounder Armstrong, throwing the same form of shot, did not penetrate 3-inch plates at 100 yards.

The wall-piece, throwing a flat-headed tempered steel projectile, penetrated 1-inch copper plates at 25 yards.

The iron shield fired at in the autumn was another Thorneycroft, 4 inches thinner than the one previously

tried at Portsmouth: the rolled bars being 10 inches wide by $4\frac{1}{2}$ inches thick. Unlike the Portsmouth shield the cohesion was secured by vertical tie bolts and clamps into masonry behind. The results at 600 yards were—

The 68-pounder indentations of $1\frac{1}{8}$ inch to $1\frac{1}{2}$ inch.

80-pounder	„	„	1
40-pounder	„	„	$\frac{3}{4}$
Grapè	„	„	$\frac{1}{4}$

The shield was next tried with masonry supports at the ends only; none in the middle; and it stood nearly as well as with the complete masonry backing. No indentation exceeded $1\frac{1}{2}$ inch, and there were 29 hits from 68-pounders, 80-pounders, and 40-pounders at 600 yards. Subsequently the shield yielded to the 120lb. shot from the Armstrong shunt gun, and was completely broken up by the 156lb. shot of the 12-ton Armstrong shunt gun at 200 yards.

The Third Thorneycroft. A third Thorneycroft shield was afterwards tried, of the absurd thickness of 8 inches. That thickness could not stand two 68lb. shot near each other, and was annihilated by the Armstrong 100-pounder. Why so many trials of the Thorneycroft wall system were made was owing to the simplicity and cheapness of the structure, the cost being £15 a ton against £45 or £50 if constructed in any other manner. The recent shield manufactured for the defence of Cronstadt is a modified Thorneycroft constructed in the following manner—in some of the words in my own report. Looked at in front, and especially so at a distance of 100 yards, it might be taken for an ordinary work of masonry some 40 or 50 feet long and 10 or 12 feet high, with three embrasures. Close inspection, however,

discloses the succession of iron layers or bars 12 by 12 inches, extending a third of the length, with alternate or zig-zag flush bolt and nut fastenings at the butts to rear. The side or end views reveal the construction. They resemble an inclined capital letter A, the front of the shield being the vertical arm and the inclined arm the supports. The cohesion of the bars is secured by dovetailed projections and recesses, and the cohesion to the rear supports in the same manner, each layer or bar having a rear projection which keys into a corresponding recess in the front of the supports. The supports are four in number, measuring at the bottom 4 feet and at the top 18 inches. The weakness of the embrasures is compensated by additional box buttresses keying also into the layers of brass.

With the fate of three Thorneycroft shields before us, it is certain that the 12-ton Armstrong would soon demolish it. But of course the attack would also be subject to demolition in the attempt; and no attack can possibly have so well covered guns.

CHAPTER XIV.

EXPERIMENTS IN 1861.

At Fault—the Scent Lost. The year 1861 opened miserably on those charged with the armament of this great commercial country. The official mind was in a state of collapse. Iron appeared after all to be iron, and not the clay which it was believed. His Grace the Duke of Somerset, following a time-honoured naval custom, took off his beaver and danced upon it. Lord De Grey summoned to his side the various committees for the same purpose that Pharaoh summoned the wise men of the East and the magicians, for the interpretation of his dream. His lordship's dream was that he was on the wrong side of the ditch or hedge, and that the sooner he was on the right side the better. The committees explained everything, discussed everything, and suggested everything. Like lost sportsmen in the Canadian bush, after the last words of the most talking man of the party had been given, none could tell north from south, and no one conscientiously affirm that he knew the trail which for some time they had been following. The committees were in the woods, and Lord De Grey and the Duke of Somerset felt like men whose senses had taken leave of them. In their extremity their lordships

caught at the straws of two targets from Mr. Hawkshaw, Captain Coles's cupola, one target from Mr. Fairbairn, and one from Mr. Roberts. It will be seen presently that the straws made confusion worse confounded.

Mr. Hawkshaw's Targets. Mr. Hawkshaw's targets were two in number, the one composed of an outer $1\frac{1}{2}$ -inch plate and seven 5-8-inch plates—boiler plates—all bound together by alternate screws and rivets. These eight thicknesses formed a target six inches thick. The other target was composed of an outer plate 2 inches thick and thirteen 5-8-inch plates—boiler plates—all bound together as before. Great results were anticipated from the clever combinations; but what happened was that at 200 yards the 68-pounder passed through the structures, breaking off a shower of rivet heads. Even the 40-pounder Armstrong at 100 yards did a considerable amount of mischief.

Notwithstanding the failure of Mr. Hawkshaw's system, it was the ready make-shift one of the United States, and most of their ironclads are armoured in that manner. Lake Superior iron has, however, entered largely into the manufacture of American armour, and the iron ore of that region surpasses that of all others in all the essential qualities.

Captain Coles's First Cupola. Captain Coles's first cupola, constructed by the Admiralty, was fired at in the autumn of 1861 on board the "Trusty;" and the sensation is a new one to read over the simple facts and afterwards reflect on all that has been said and written on the subject; and especially to reflect on the indecision of the Admiralty. The trial was fairly and fully made, and was decisive of the merits of the invention of Captain

Coles. But the question fell immediately into the hands of the gentlemen of Captain Coles's own profession, into the hands of the hangers-on at the Admiralty, whose best chance of notice and advancement is in opposing everything. Those gentlemen are in the main responsible for the bewilderment of the Duke of Somerset and Lord De Grey on many more questions than that of cupolas. In their justification it may be urged that the Duke of Somerset and Lord De Grey ought to know when the wool is drawn across their eyes; but it might as well be said that the guilty should always pass unpunished. The facts of the first trial of the cupola are simply that the firing was under all conceivable conditions and the cupola proved a perfect success—the "Trusty" was heeled over several degrees without the cupola working less satisfactorily—the facilities for rapid and accurate firing, and for following a moving object, were demonstrated—and with a comparatively small crew. Finally, the cupola was struck twenty-six times from the 100-pounder at 200 yards, four of the shot passing through it, the machinery still working as well as ever; and afterwards the 68-pounder was laid on it at 200 yards without once throwing it out of gear. Moreover, the smoke inside the cupola gave no trouble.

Mr. Fairbairn's Target.

Mr. Fairbairn's target was one of great promise, owing to the assumed knowledge of iron possessed by that gentleman. It was, however, a failure—a failure as complete as any ever recorded at Shoeburyness. Mr. Fairbairn thought that if he interposed elm planking between the shot and the armour, the armour would remain uninjured, and that if he secured the armour behind with screws, the screws would hold, and he would get rid of the infirmity of through bolting.

Both assumptions were fallacious, and they constituting the principle of the target, the failure was unredeemed by a single good point or feature. The face of the target consisted of 4 inches of elm planking, the centre of 5-inch armour plates suspended to $3\frac{1}{4}$ -inch sheathing, the rear to ribs of $\frac{1}{2}$ -inch plate, 12 inches deep and 18 inches apart. The screws were $7\frac{1}{2}$ inches apart, tapped 2 inches into the back of the plates. Under fire the tap screws broke off, and the armour became completely separated from the rear part before a single plate had been penetrated.

Mr. Roberts's Target.

Mr. Roberts's target was one of the most complicated ever fired at in this or any other country. It presented to the guns the aspect of a potato or turnip field, being a series of ridges and furrows, or angular projections, the apices of the angles pointed with steel. The guns, as if in derision of the innovation, opened the ridges and widened the furrows; a few rounds of 68lb. and 100lb. shot ruining the target. The structure was a mass of timber and T plates, faced with armour 3 and 4 inches thick and 2 feet wide, the projections partly rolled and partly hammered.

Such were the experiments on which the authorities relied to clear away the fog in which the question of the armaments of the country were enveloped. But there were some more futile experiments throughout the year. These were—

Brickwork Backing.

Granite backing having proved too brittle, some one or other thought of brickwork backing, and various thicknesses of armour were secured to a brick wall. The result was that $3\frac{1}{2}$ -inch armour so secured would keep out the shot of the heaviest battering guns

in the service at the present time. At 600 yards a 12-pounder solid shot had no effect. At the same range a 40-pounder cast-iron shot was repelled by a $3\frac{1}{2}$ -inch plate. At 500 yards a 68-pounder cast-iron shot penetrated the $3\frac{1}{2}$ -inch plate.

Inclined Plates again. The inclined plate question, experimentally disposed of at Portsmouth in 1860, was again revived, and again disposed of in the same manner—shot moving at high velocities delivering the same blow whether the target is vertical or inclined. Two plates were secured to 12 inches of oak backing, the vertical plate $4\frac{1}{2}$ inches thick and the inclined plate—inclined to an angle of 45 deg.— $3\frac{1}{4}$ inches thick. Both were fired at from a 40-pounder Armstrong at 100 yards with precisely the same effects, the indentations in both cases being 8·10 inches. Afterwards, at 200 yards, a hemispherical-headed 100lb. shot passed through the inclined plate, but not through the vertical one.

Various Backings. Various backings were next tried to arrive at a definitive conclusion on the subject of backings. The backings tried behind $2\frac{1}{2}$ -inch plates were first, blocks of cast-iron 3 feet thick; second, solid granite; third, a mass of 10 by 10 oak; fourth, alternate layers of fir and cork; fifth, bitumen and cork. The results were, 1st, that rigid backing spares the plates and tries the fastenings; and 2d, that elastic backing spares the fastenings and tries the plates. The 40-pounder Armstrong at 200 yards, with cast-iron shot, did little harm to the plates backed by granite and cast-iron, but penetrated the plates with the oak and the fir backings. Several of the bolts of the granite and cast-iron backings were broken off; none of the other bolts were injured.

The Warrior Target.

Then came the Warrior target, as if for the purpose of once more confounding the authorities; for they were confounded. All the other targets of the year had been demolished—effects establishing the superiority of the guns—and the Warrior target resisting the guns raised a presumption on the other side—against the guns. The Warrior target received thirteen 68lb. shot and six experimental 200lb. shot from a 100-pounder with a reduced charge, and ten shell, without the sheathing and ribs proper of the ship being injured.

An accurate description of the section of the Warrior is much wanted. It is as follows:—the ribs of the ship are from 27 to 25 inches apart—they are 10 inches deep, made up of $\frac{1}{2}$ -inch web and L irons, 4-inch by 3-inch by 5-8 in. On the face of the ribs there is a sheathing of 5-8 inch plates, and outside the sheathing strengthening pieces of 5-8-inch plates, covering the joints of the armour, and nearly half the area of the side. Next comes $9\frac{1}{4}$ inches of teak laid horizontally, and $7\frac{3}{4}$ inches laid vertically. On the vertical teak, $4\frac{1}{2}$ -inch armour, tongued and grooved on the edges, is secured by $1\frac{1}{2}$ -inch bolts; the bolts being in the proportion of one to each $3\frac{1}{4}$ superficial feet of the ship's side.

CHAPTER XV.

EXPERIMENTS IN 1862.

The Situation.

The situation at the beginning of 1862 was such as is inseparable from a want of courage. There were facts to repletion which, if wisely digested, would have indicated with unerring certainty the right and wrong paths to be pursued, but the digestion of no man in office was equal to the task. While digestion was unheeded there was, however, a craving—an unhealthy craving—for new and stimulating food. The Iron Plate Committee and Mr. Fairbairn desired to try their hands, and Messrs. Scott Russell and Samuda, two naval architects of repute, supposed they knew a thing or two; while Messrs. Whitworth and Armstrong were in a state of intense anxiety for fresh opportunities on the other side. Indolent committees and indolent rulers could only yield. Accident might disclose that which it was their duty to discover. Business-like committees and business-like rulers taking the bull by the horns would have arrived at this—the Warrior target has succeeded where the others failed, because of some point of excellence in that target. The next step would have been to find out wherein the merit of the Warrior target lay, and the truth revealed, they would at once have found

themselves on the high road to a graduated system of targets to repel the 5½ oz. cylinders of the wall-piece, and perhaps, also, the projectiles of the great calibres. The end of the target question would at least have been reached, whether it led us to structures which no ship could carry, or to the entire abandonment of armour, unless for the facing of our great defensive works. Two years would also have been saved to the country, and a large amount of money.

The Committee Target. The Committee target, proposed and made by Mr. Fairbairn, furnishes another illustration of the worthlessness of the opinions entertained on iron combinations by even the most eminent mechanicians of the time. Mr. Fairbairn thought, and the committee thought—and, to do them justice, many others thought the same thing—namely, that it was because the Warrior was an iron and not a wood ship that its armour stood so well; therefore, they said, let us have an entire iron target and we shall have exactly what is wanted. The target therefore differed from the Warrior in the absence of wood; and to compensate for the wood there were additional ribs, plates, and angle irons. Altogether the weight exceeded that of the Warrior target, and to that extent it had the advantage of the Warrior. Mr. Fairbairn was confident, the committee were confident, and the Duke of Somerset and Lord De Grey were confident. Hints were, moreover, thrown out in the newspapers that something decisive in respect to targets was to come off at last; something worthy of the manufacturing genius and the science of the United Kingdom. After the trial, a friend of Mr. Fairbairn's cruelly proposed that the Southend hearse and mourning coaches should be sent for to take the

inventor and the committee to the railway. The committee and Mr. Fairbairn were, however, not to be caught napping, and, to the amusement of the Shoe-buryness officers and others, coolly stated that the target had been invented for no other purpose than trying the value of the 17 inches of the Warrior teak backing. Of course the value of the presence and absence of backing had been tried before—some such trials being recorded in the previous pages—but it would not have done for the committee to have left the ground with their fingers in their mouths like common-place unfortunates. The same blows which the Warrior target had resisted destroyed the fastenings of the Committee target, and if continued beyond a judicious period, the plates would have dropped from their iron cushion.

Some weeks after the committee, not yet to be beaten if a loophole remained for an escape, ordered the stripping of the plates, and the refastening of them with felt dipped in tar, tarred oakum, and vulcanised india-rubber between the armour plates and the iron skin, and indiarubber washers on the bolts. These milk-and-water remedies were unavailing, the target being as useless as before.

Mr. Scott Russell's Target. Mr. Scott Russell superintended the erection of his target with great patience, and with his well-known skill. But he answered questions nervously, fearing, no doubt, the fate of Mr. Fairbairn, and remembering the well-known lines—

Ah me! what perils do environ
The man that meddles with cold iron.

Mr. Scott Russell being a man of iron, his target was an iron one. He had faith in nothing else, at least until

the second failure of Mr. Fairbairn. His target was an embodiment of the rather common-place idea one meets with every day in the extension dining-table or in book-case doors—the armour plates sliding on the face of the target in rows, to be held together in the top and bottom grooves. Primarily the intention was to meet the objection to bolt fastenings—then a great weakness—and secondarily to allow of the easy repair of the sides of ironclads after action by merely bringing reserve armour plates from the hold and pushing them into their places along the grooves. The guns, however, did not take kindly to Mr. Scott Russell's good intentions; the target falling greatly short of the Warrior standard. The 68-pounder and 110-pounder Armstrong punished it severely, while the 156lb. spherical shot from the 12-ton gun at 200 yards breached the side. Recently a wrought-iron round shot from the same gun, with the same charge of 50lb., opened another hole, and scattered the inboard with deadly splinters. The armour plates of the target were $4\frac{1}{2}$ inches thick, backed by 3 inches of iron in three thicknesses, and supported by sheathing of two thicknesses of 3-8-inch boiler plate, with ribs $10\frac{1}{2}$ inches deep and 1 foot 9 inches apart. The refinement of continuous riveting need not be noticed. All that could be done by Mr. Scott Russell to insure success was done, and he has not been often at Shoeburyness since. He was not consulted again by the grateful committee, although his claims to be so, as a worker in iron, a practical shipbuilder, a devoted man of science, a scholar, and a gentleman, entitled him to as much, if not more, consideration than Mr. Fairbairn or half-a-dozen others who might be named. Mr. Scott Russell's labours entitle him to the respect of all men, although of late years there has been no surer means of rising at

the Admiralty than by decrying him. To that pass we have really come.

Mr. Samuda's Target. Mr. Samuda was the third man of iron brought to the surface about the same time in 1862. He has been and is a most successful iron shipbuilder; one of the shrewdest and most active men of business of the many on the Isle of Dogs. His target, designed and constructed by himself, consisted of 5-inch armour plates resting on 1-inch plates, and supported by ribs 7 inches deep and 2 feet 2 inches apart. The joints of the plates were, in addition, covered by $2\frac{1}{2}$ -inch pieces. The guns manifested as little favour for this combination as for the others. The 68-pounders and the 110-pounders punished it, and the 156lb. round shot passed clean through. Mr. Samuda did not trouble himself further about targets, and the committee, instead of acting on the facts before them, determined on a reproduction of the effects on the Warrior target by ordering a new one for trial.

A New Warrior Target. The new Warrior target stood the usual 68-pounder and 110-pounder tests at 200 yards, and was opened on by the 12-ton gun with spherical 156lb. shot at the same range. The first shot passed through the armour and shattered the teak backing at the point of impact, but did not break the inner iron skin, although the skin and ribs were bulged. The second shot lodging within a foot of the previous one, greatly enlarged the area of destruction, but did not pass the inner skin. Three more shot were fired at parts of the target which had not suffered from the preliminary or test rounds, and merely penetrated the armour, leaving the inner skin and ribs uninjured. Not one of the three shot would have been felt on board ship.

But the shot were cast-iron, not wrought-iron; and wrought-iron shot, it will be seen by and by, were afterwards more fatal to the Warrior than the cast-iron had been to the three great iron targets—the Fairbairn, the Scott Russell, and the Samuda.

The Minotaur Target. The Minotaur target still intervened between the iron targets and the distracting experiments with the Armstrong and Whitworth guns. That target possesses the same ribs and inner skin as the Warrior, but in place of 17 inches of teak there is only 9 inches, and instead of $4\frac{1}{2}$ inches of armour there are $5\frac{1}{2}$ inches. In comparative penetration, without exterior covering or rear support, 1 inch of armour is the equivalent of nearly 9 inches of teak; so that theoretically the one target should be as good as the other. And seldom have theory and experiment been more in harmony; the Minotaur target being fully up to the Warrior standard. The three armour plates on the experimental target were the production of three makers—one by John Brown and Co., Sheffield, measuring 12 feet 6 inches by 3 feet 4 inches; one by the Thames Iron Works, measuring 9 feet by 3 feet 7 inches; one by Messrs. Beale, measuring 12 feet 6 inches by 3 feet 4 inches. At the back of all the joints of the plates there were junction pieces $1\frac{1}{4}$ inches thick. The guns, charges, velocities, and shot were as follows, at the usual range of 200 yards:—

12-ton gun; 50lb. charges; 1,700 to 1,750 feet velocity; 150lb. cast-iron shot; 162lb. wrought-iron shot.

68-pounder; 16lb. charges; 1,530 to 1,580 feet velocity; 67lb. cast-iron shot; 71lb. wrought-iron shot.

The first 150lb. cast-iron shot struck the Thames Iron Works plate, penetrated the armour, and became bedded

in the armour, doing an inconsiderable amount of injury. The second 150lb. cast-iron shot struck the Sheffield plate, doing a similar amount of injury. The third 150lb. cast-iron shot struck the Beale plate, and made a hole through everything. All three plates were buckled; there were ribs cracked, bolts broken, and skin bulged. The first 162lb. wrought-iron shot struck the Thames Iron Works plate, penetrating the armour, pounding the backing and buckling, and shaking up the target. The gun firing the round—an Armstrong shunt muzzle-loader—burst, the breech being blown out some 20 or 30 yards to the rear. The bursting of the gun perhaps diminished the effect of the shot, and it stopped the practice at that point with the 12-ton gun. The 68lb. cast-iron shot, and the 71lb. wrought-iron shot, made a maximum indentation of only $\frac{1}{2}$ inch.

These facts do not bear out the hue and cry which the professional defamers have from time to time raised against the Minotaur, and the two sister ships, the Agincourt and the Bellerophon, in respect to backing and armour. If the previous experiment is turned to, it will be seen that the 150 cast-iron shot did much the same mischief to the new Warrior target. As a matter of fact, the Minotaur target is the equal of the Warrior target; and all that is stated to the contrary is incorrect.

It is worth while adding that all the Crosby Sand experiments with the Mackay gun have been upon a Minotaur target, the production of the Mersey Iron Works, which are as unexceptionable makers as any in the kingdom.

A new Committee Blunder. At this point the indolence and incapacity of the committee stand out with painful pro-

minence. The committee had been consulting and experimenting for two years—they had seen the unfitness of all iron and of various compounds—and they had seen, or ought to have seen, that the path of inquiry lay between or in the direction of the Minotaur or the Warrior. What did they do? They mixed the knotty question of the guns with the targets, which in a certain sense had nothing to do with their inquiry. It will be seen presently what followed, and although it was quite right that the guns should be tried, no stronger reason could be urged against the blending of armour-plate and gun inquiries than the one that, because of the blending, we to this hour, depending exclusively on the committee, remain in the dark both in respect to guns and armour. One thing at a time is a wise maxim, and one which, if remembered at the War-office and the Admiralty in 1862, would have saved the country a large sum. The oversight, however, provided work and pay for the committee, for which, no doubt, they were very thankful.

The Horsfall Gun Effects.

The Horsfall gun effects were now tried on a Warrior target; a Warrior target, too, which, in the ostentatious generosity of the committee, was not manufactured at the Thames Iron Works, and on the test rounds with the 68-pounder at 200 yards, with 16lb. charge, gave an indentation of 4 inches in the armour instead of 2 inches, the Warrior standard. As the target was not made by the Mersey Iron Works, they, the makers of the Horsfall gun, are free from blame. The Horsfall gun is of the following dimensions:—Length, from breech to muzzle, 16 feet; length of bore 13 feet by a diameter of 13 inches. The finished weight of the gun is 24 tons 3cwt. 2qr. 21lb.; the unturned

and unbored forging weighed 28 tons 1cwt. 3qr. 21lb. The Mersey Iron Works presented the gun to the nation; and the representatives of the nation, to mark their sense of the patriotism of the donors and the value of the gift, have, I believe, arranged for the mounting of the gun in a glass case in the School of Naval Architecture at Kensington. The little game of the representatives of the nation would have been spoiled had the Horsfall gun received the same attention as the Armstrong and Whitworth guns. I know exactly what the Mersey Iron Works should have done as an accompaniment to their national gift. But to say so would be digression. The gun was laid on the Warrior target at 200 yards, charged with 74·40lb. powder and a cast-iron shot weighing 279lb.; and the initial velocity was 1,630 feet per second, reduced to 1,610 feet at 40 yards. One shot sufficed at the 200 yards; the shot passed through everything, making a hole 2 feet square in the armour and 3 feet square on the inner skin. The gun was afterwards placed on the 800 yards' range, charged as before with 74·40lb. powder, but throwing an annealed cast-iron shot weighing 285lb., the terminal velocity of which was 1,300 feet. The effect of that shot at 800 yards was much the same as the effect of the 150lb. cast-iron shot on the Minotaur and the Warrior target proper at 200 yards—the armour was completely penetrated, the backing crushed, and the inner skin bulged, with ribs and bolts broken. In a word, the Horsfall gun was a complete success; as complete a success as any yet attained with the same shot from a like calibre.

What did the committee do? They never gave the gun another trial from that day to this. They complained of serious-looking flaws in the bore, and that the gun—not the gunner—made very bad practice at the

800 yards. The destruction of the Warrior target at 800 yards, however, opened their eyes to a new and boundless field of inquiry, and they waited the appearance on the ground of Sir William Armstrong and Mr. Whitworth with some anxiety.

The Whitworth Penetrations, 16th and 25th Sept.

Mr. Whitworth, to the delight of the committee, placed upon the marsh a display of guns, the like of which has not been seen again; there being no more 12-pounder breech-loaders, and no more 120-pounders. The battery comprised a 12-pounder breech-loader, weighing $9\frac{3}{4}$ cwt.; a 70-pounder muzzle-loader, weighing 76cwt. 2qr. 14lb.; and a 120-pounder muzzle-loader, weighing 148cwt. 3qr.; all Whitworth guns. Three targets were provided for the 12 and 70-pounders; the 120-pounder was fired against the Horsfall Warrior target, and afterwards against a specially constructed box target, with an interior cubical capacity of 435 feet. Guns, ammunition, wads, friction tubes, projectiles, and targets were, I believe, paid for by the public, and the general results arrived at were—

1st. (Positive).—The use of better metal in shells, which enabled them to penetrate the $4\frac{1}{2}$ inches of the original Warrior target without breaking up.

2d. (Negative).—The skin of the Warrior not penetrated before the bursting of the shell: therefore the shell were practically powerless against the Warrior. In other words, the damage between decks was trifling, and would neither have disabled guns nor gunners.

The 12-pounder was laid first, against an unbacked $2\frac{1}{2}$ -inch plate at 200 yards—the shot a solid homogeneous metal, cylindrical, flat-end one, weighing 12lb. 1oz.—the charge 1lb. 14oz. The initial velocity of the shot was 1,360 feet per second, and the shot

passed through the plate, dropping a short distance behind. The gun was next laid against a 2-inch plate, backed with 12 inches of oak, at the same range—the shell, of homogeneous metal, weighing 12lb. 2½oz.—the charge 1lb. 14oz., and 6oz. of powder in the shell. The initial velocity was a trifle greater, and the shell passed through plate and backing into the earth behind, without bursting.

The-committee were in ecstasy, and Mr. Whitworth was in danger of getting his neck broken by the proposed carrying out of the generally expressed desire that he should be taken to the mess-room on the shoulders of the committee. He was a marvellous man. He had thought of and made use of that which the committee until doomsday would not have dreamed—namely, the manufacture of shot and shell from good material instead of bad. That was the head and front of Mr. Whitworth's genius on the occasion. The committee, however, to divert attention from the course they were pursuing, and from their indolence and incompetence, uttered the most fulsome praise. It was true that previously no shell had ever passed through 1-inch iron without breaking up—but that was because our shell had been made of much the same material as kitchen-stoves and smoothing-irons. It was true that previously no steel shot had passed through 2-inch iron without breaking up, but that was because the makers of the steel shot had made them hap-hazard, without experience to guide them in the hardening.

The 70 pounder was laid against a box target, constructed so as to demonstrate the effects of Whitworth shell on board ship—between the ship's two sides or walls. The face of the box was constructed of 9 inches of teak, with 4 inches of armour bolted on it;

the sides were 4-inch elm ; and the back was 4-inch elm and 2-inch armour bolted on it. The range as before was 200 yards, the shell of the same material and form as the 12-pounder shell, but weighing 69lb.—the charge 12lb., and 2lb. 6oz. of powder in the shell. The initial velocity was 1,275 feet per second, diminishing 10 feet per second at 40 yards, and the shell passed through front and rear of the box before exploding. That was evident from the $2\frac{1}{2}$ -inch indentation in the rear plate, and from the sides of the box all falling outwards. The cubical contents of the box were 35 feet.

Why the face of the box did not correspond either with the Warrior or the Minotaur admits of no explanation. It was one of the foolish oversights of the foolish committee.

13th and 14th November. The 120-pounder was next laid against the 435 feet box target at 800 yards. That target corresponded with the original Warrior target, with the difference that while the upper plate was taken from the original Warrior target the two lower plates were from the Samuda target, and were 5 inches thick instead of $4\frac{1}{2}$ inches. The box rested on the committee's Fairbairn target—that target forming its rear side or wall—and the sides proper and the roof and floor were formed of 12-inch oak firmly bolted and secured. Two rounds of flat-headed homogeneous metal shell, weighing 151lb. each, and containing 5lb. of powder each, were fired with 27lb. charges, which gave a velocity of 1,175 feet at 780 yards. The one found its way into the box through the $4\frac{1}{2}$ -inch plate, and the other through one of the 5-inch plates. There was no effect on the rear wall of the box ; a good many splinters were upon the floor ; and the inner skin of the front wall had

a hole about 10 inches square. Apparently there were no shell effects, although the shells had both acted, the one prematurely and the other too late. A solid shot moving at the same velocity would have done exactly the same execution. A cast-iron flat-headed hollow shot, weighing 130lb., was next fired at one of the 5-inch plates, and striking with a velocity of 1,200 feet per second made an indentation of 2·3 inches. A homogeneous solid shot of the same weight, and moving at the same velocity, passed through the front wall, doing much the same execution as the shell. Last of all a flat-headed homogeneous shot, weighing 130lb., with an increased bursting charge—a 9lb. 8oz. bursting charge—struck a 5-inch plate at a velocity of 1,240 feet. The effect was the greatest of all, a large irregular hole being made in the inner skin of the front wall through the acting of the shell at the right instant.

Three shell, flat-headed, homogeneous metal, were next fired from the 70-pounder at the 600 yards' range. The three penetrated the 4½-inch and 5-inch plates and burst in the backing, but did not destroy the inner skin of the front wall. Against the Warrior target the 70-pounder was therefore powerless; and the only really destructive shell was the 130lb. one with the 9lb. 8oz. bursting charge. I believe I am correct in stating that the 120-pounder has not been fired again, and that after the five rounds—the only rounds it ever fired—it was not in a condition to be fired again with safety. I believe I am also correct in stating that Mr. Whitworth has not since ventured on the manufacture of so large a gun as a 120-pounder on his own peculiar principle of construction, but has since been indebted to the Armstrong principle of construction in all the moderate-sized guns that the Manchester Ordnance Company have turned out.

Minor Experiments.

Messrs. Beale, of Rotherham, provided some rapidly cooled $4\frac{1}{2}$ -inch plates, the cooling taking place by immersion in water. The process was so injurious that the cooled plates were penetrated 4 inches by the 68-pounder, instead of 2 inches had there been no cooling. A comparative trial of Armstrong and Whitworth breech-loading 12-pounders against $4\frac{1}{2}$ -inch plates at 100 yards, the Whitworth being beaten. The Whitworth penetration was 1·4 inches; the Armstrong flat-headed shot $\frac{1}{2}$ inch; the Armstrong round-headed rather more than 2 inches.

The Whitworth 12-pounder was tried against inclined $2\frac{1}{2}$ -inch plates, and the homogeneous shot and shell passed through them. Cast-iron shot broke up, making a trifling indentation. The angle of the plates was 45 deg.

Captain Inglis's Shields.

Two of Captain Inglis's shields were tried in the course of the year. The shields were designed for the fronts of masonry casemates. Giving Captain Inglis's own words—the first one “was composed of planks of wrought-iron, first hammered and then rolled, 5 inches thick and 14 inches wide, crossing each other in alternate layers at right angles, representing what is called in carpentry ‘planking and cross-planking.’ One half of the shield had two layers of planks, and was therefore 10 inches thick, and the other half had three layers. The several layers were secured by $2\frac{1}{2}$ -inch bolts, and each nut had two washers, one of iron and one of lead.” The shield resisted pretty successfully all the guns up to the 12-ton gun, with a 50lb. charge, at 100 yards. Some of the bolts gave way, and the planks were cracked through the bolt holes.

The second shield was much more complex. Captain

Inglis said of it—"The vertical face planks of hammered iron are of various sections—namely, 23 inches by 8 inches, 23 inches by 7 inches, $19\frac{1}{4}$ inches by 8 inches, $19\frac{1}{4}$ inches by 7 inches, and $19\frac{1}{4}$ inches by 6 inches. These were backed by horizontal planks of rolled iron 14 inches by 5 inches, and secured by 3-inch screw bolts to a framework in the rear. The framework consisted of four vertical pieces, 14 inches by 4 inches, and two horizontal pieces, 14 inches by 5 inches, and the whole was supported at either end by a boiler plate diagonal strut, having a base of three feet, and made up of a web of 1-inch plate and angle iron stiffening pieces 8 inches by 5 inches by 1 inch, and 5 inches by 5 inches by 1 inch."

The shield was subjected to a very trying ordeal, and was greatly shaken.

CHAPTER XVI.

EXPERIMENTS IN 1863.

The Voracious Committees. The beginning of 1863 found the committees lying back on easy chairs, smoking pipes, and ringing the waiter's bell for another 'go' of cold brandy. Shoeburyness had become an institution, the experiments had become an institution, and the committees had become an institution. The committees were laying all generations of living and unborn Englishmen under everlasting obligations. When they yielded to the persuasion of Lord De Grey and the Duke of Somerset to serve on the experiments they had not the remotest idea of the great duty they were called on to discharge. [Touch the bell, Mr. President, and ask the waiter whether he can recommend the Southend natives.] Yes, the duty was a most essential one for the honour of the three kingdoms, and he would be a bold man who ventured to affirm when the tether's length of the committee would be fairly reached. England, you see, is a free country, which is one point; the position of England, you see, is insular, which is another point; and, you see, Englishmen are the machinists of the world, which is another point. The inventive genius of a people so peculiar fairly promised

grist to the committee mill until God knows where we should be, in respect to targets, guns, shot, shell, gun cotton, metropolitan sewage, and American negroes. One thing alone was clear, and that was that the committees should rest upon their oars. When so many were doing, so many pestering them with plans, drawings, propositions, inquiries, solicitations, remonstrances, appeals, threats, and so on, they would be acting in the spirit of their instructions were they merely to pass judgment on the effects brought before their notice; merely to allow invention to work out its own salvation in fear and trembling. And taking that course the hands of the committee would be full. There were plates of untried thicknesses to be fired at with untried guns and projectiles. There were the Chalmers target, the Clarke target, the Bellerophon target, and the floating Warrior target for the 600-pounder; besides sundry minor experiments for the settlement of such knotty questions as might arise. The committees, therefore, took 1863 easy. They made themselves so much at home in Southend and at Shoeburyness, and ordered so many requisitions on the military chest at Woolwich, that Lord De Grey took fright, removed General Taylor, and, as already told, reduced the Shoeburyness allowances some £400 per annum.

Thick Plates, 17th March. The thick plates were three in number, the manufacture of Messrs. John Brown and Co., Sheffield, and of the following dimensions:—

One 13ft. $4\frac{1}{2}$ in. by 3ft. 7in., and $5\frac{1}{2}$ in. thick.

One 12ft. $2\frac{3}{4}$ in. by 3ft. $7\frac{1}{2}$ in., and $6\frac{1}{2}$ in. thick.

One 11ft. 9in. by 3ft. $8\frac{1}{2}$ in., and $7\frac{1}{2}$ in. thick.

They were fastened to the skin and frame of the Samuda

target, and each plate was contrived to serve for two targets; the one half of each plate having only the skin and frame of the Samuda target behind, and the remaining half of each plate having from 7 to 9 inches of teak between the plate and the Samuda target. Of course there was a corresponding hollow between the other half of the plates and the Samuda target. Indiarubber washers were used with the nuts. The guns in position at 200 yards on the marsh were—

- One 68-pounder service 95cwt. gun.
- One 110-pounder Armstrong breech-loader.
- One 7-inch Whitworth gun.
- One 9-inch Lynall Thomas-Armstrong.
- One 300-pounder Armstrong shunt muzzle-loader.

The test rounds from the 68-pounder and the 110-pounder Armstrong gave the following indentations:—

Plates.	5½-inch.	6½-inch.	7½-inch.
68-pounder ...	2 inches	1½ inches	1½ inches.
110-pounder ...	1·9 „	2·05 „	1·65 „

The Armstrong 300-pounder and the Lynall Thomas-Armstrong 9-inch gun were the only guns available for the 7½-inch plate, Mr. Whitworth not then and not now possessing a sufficiently large gun. The cylindrical steel shot of the Armstrong gun weighing 301lb. was fired with a 45lb. charge against the teak-backed part of the plate, and at 30 yards in front of the target it had a velocity of 1,295 feet per second. The shot rebounded from the target after penetrating 6·2 inches and inflicting the usual injuries inseparable from all penetrations. The hardened steel shot of the Lynall Thomas-Armstrong gun, weighing 330lb., was fired with a 50lb. charge against the teak-backed part also, and at 25

yards in front of the target had a velocity of 1,220 feet per second. The area of destruction on the face of the target was as near as can be double that in the other case, and the penetration was also greater, being 7 inches. A spherical wrought-iron shot, weighing 163lb., with a charge of 45lb., and a velocity of 1,630 feet per second, 30 yards in front of the target, made an indentation of $3\frac{3}{4}$ inches on the unbacked part of the target and to some extent cracked and bulged the plate.

The $5\frac{1}{2}$ -inch plate received the fire of the Armstrong 300-pounder and of the 7-inch Whitworth gun. The Lynall Thomas-Armstrong shot was foul, falling partly on the $6\frac{1}{2}$ and partly on the $7\frac{1}{2}$ -inch plates. The cylindrical steel shell of the Armstrong weighed 288lb., contained a bursting charge of 11lb., and was fired with a charge of 45lb., which gave a velocity of 1,320 feet per second at 25 yards in front of the target. The shell struck the teak-backed part, carried a shower of fragments in board, and set the backing on fire. The cylindrical flat-headed homogeneous metal shell of the Whitworth, weighing 148lb, had a bursting charge of 5lb. 12oz., and was fired with a charge of 25lb., which gave a velocity of 1,265 feet per second at 30 yards in front of the target. The shell struck near where the Armstrong one had made havoc, punched out a clean hole 9 inches in diameter, exploded in the backing, and blew a minor shower of fragments on board. The foul shot of the Lynall Thomas-Armstrong gave an indentation of 6 inches in the $7\frac{1}{2}$ -inch plate, and of 4 inches in the $6\frac{1}{2}$ -inch plate.

The Chalmers Target,
27th April.

The Chalmers target formed one of half-a-dozen moves which any observant players might have made on the Shoeburyness

chess-board. Mr. Chalmers had seen or heard of the Fairbairn and other failures, and the facts of the Minotaur and the Warrior trials were before him. So were many other facts. All wood was useless; all iron was useless; the simple combinations of wood and iron in the Warrior, and of alternate—so to speak—combinations of the same in the Minotaur had beaten everything. Mr. Chalmers thought of a more elaborate Minotaur; a target which would dispose of the simple combination of wood and iron in the most effective manner. The side of the Chalmers target differed in the gross from the Warrior in this—that whereas the Warrior had $4\frac{1}{2}$ inches of armour and 17 inches of teak, the Chalmers target had 5 inches of armour and 15 inches of compound iron and wood backing. The figures are as $21\frac{1}{2}$ against 20; the weight 20lb. per superficial foot greater than the Warrior. In detail, the side of the Chalmers target differed from the Warrior in this—that whereas the Warrior had all its $4\frac{1}{2}$ inches of armour on the face, and all its 17 inches of teak behind the armour, the Chalmers target was faced with $3\frac{3}{4}$ -inch armour; behind which there were horizontal wrought-iron ribs 10 inches by 7-16-inch in alternate layers with 10 by 5-inch timbers, the mass bolted together by vertical screw bolts of 1-inch diameter; behind which again there was a plate $1\frac{1}{4}$ inch thick; and next 5 inches of teak as a cushion between the whole and the skin and ribs of Mr. Chalmers' intended ship. The Warrior offered a double resistance of armour and teak—the Chalmers target a quadruple resistance—1st, the resistance of the armour; 2d, the compound resistance of 10-inch iron ribs and 10 inches of teak endways; 3d, the resistance of a $1\frac{1}{4}$ -inch plate; and 4th, the resistance of 5 inches of teak. The letter H is not a bad illustration of the Chalmers target, the

front leg representing the armour, the cross arm the horizontal ribs and layers, and the back leg the $1\frac{1}{4}$ -inch plate and the 5 inches of teak, which are suspended from the skin and frame of the intended ship. Obviously as the letter H may be said to be the original of the Chalmers target, the letter H is a more remarkable invention than the Chalmers target. Mr. Chalmers merely supplied to the committees that which the committees were ignorant of—a practical application of one of the simplest laws of mechanics. If it is answered that on the committees were to be found some of the most eminent mechanics of the time, the fact will only furnish another example of what is not unusual—that, namely, of the profoundest mathematicians being sometimes puzzled with the working out of the simplest laws.

The firing was in the usual order, from the 200 yards' range, and the preliminary rounds with cast-iron shot from the 68-pounder gave indentations of $2\frac{1}{2}$ inches, against 2 inches on the Warrior target. The rounds from the 110-pounder with cast-iron shot gave even worse results, the indentations being from $2\frac{1}{2}$ to 3 inches. Mr. Chalmers became nervous, and the committees jocular and courageous. The committees thought they had hooked another gudgeon. The salvo of three 110-pounders throwing 200lb. cast-iron shot, followed by the salvo from two 68-pounders and three 110-pounders failing to demolish the target, Mr. Chalmers became courageous, and the committees careful and oracular. At this point the target had lost some rivet-heads, one through bolt was broken, two or three ribs were slightly bulged, and there were some fractures and bucklings about the shot-holes.

The 300-pounder was now brought into requisition, and the first round was a 300lb. round-headed cylin-

dricul steel Armstrong shot with a charge of 45lb. The shot passed completely through the target, the hole in the armour being 12 inches square, and the hole on the inner skin of the ship—not of the target but of the ship—2 feet square. The next two rounds were a 150lb. spherical cast-iron shot, which penetrated the armour and lodged in the backing, bulging the skin; and a 300lb. cast-iron shot, which did much the same damage.

Such was the Chalmers target trial; an undoubted triumph against the 68-pounder and the 110-pounder, but an undoubted failure against the steel shot of the 300-pounder. The Admiralty unfairly appropriated the compound idea of Mr. Chalmers without acknowledgment and without payment, but recently Lord De Grey has paid Mr. Chalmers' outstanding private bill. The Chalmers target was made at the Millwall Iron Works.

The Clarke Target,
7th July.

The Clarke target, constructed in the same shop at the Millwall Iron Works, and at the same time as the Chalmers target, was, if I remember rightly, taken in hand before the Chalmers target, and was therefore the first embodiment of the principle or system of cellular backing. The Clarke cells differed from the Chalmers in being divided transversely; and while behind the Chalmers cells there were a $1\frac{1}{4}$ -inch plate and 5 inches of teak cushioning, the Clarke cells were supported behind by iron only, Mr. Clarke ridiculing the cushioning idea. The Clarke target further differed from all others in the fastening of the armour plates, the plates being suspended by dove-tailed slotted bolting from behind. The area of the face of the target was 13 feet 6 inches by 10 feet in height, and the armour-plates were seven in number, each plate illustrating one of Mr. Clarke's theories on backing or fastening. The

plates varied in thickness from 3 to $4\frac{1}{2}$ inches, and the average weight was 375lb. per superficial foot, less 25lb. per superficial foot for the supports.

The preliminary rounds with the 68 and the 110-pounder were less destructive than to the Chalmers target in respect to penetration, but more so in respect to rivet and bolt breaking, bulging, buckling, &c. The mean penetration was 1.84 inch. A salvo of one 68-pounder and three 110-pounders shook the whole structure, cracked the armour a good deal, but the indentations were only from .9 inches to 2 inches in depth. A flat-ended steel jacketed cylindrical shot, weighing 109lb., was next fired from the 110-pounder with a charge of 16lb., and only obtained an indentation of 1.2-inch in one of the 4-inch plates. A spherical steel shot, weighing 156lb., was next fired from the 300-pounder with a charge of 50lb., and smashed through everything, doing great mischief. A 300lb. steel shell followed from the same gun, with a charge of 35lb., and a bursting charge of $12\frac{3}{4}$ lb., doing an equal if not a greater amount of injury. Last of all, a 100lb. cast-iron shot was fired from the 6-ton 9-inch smooth-bore Armstrong gun with a 25lb. charge. It struck a 4-inch plate, passed through it, and pounded the cells, but was resisted by the inner skin.

The target was now a wreck all over. The opinion formed by me at the time was that, as a whole, the Clarke target, with the modifications suggested by the trial, was the most successful of any that had been tried. Mr. Clarke complained bitterly of the quality of the iron, and it was unfortunate that, owing to hasty words between him and Mr. George Harrison, then the managing director of the Millwall Iron Works, Mr. Clarke was excluded from the works, and, therefore, from the

superintendence of the completion of his target. Mr. Harrison was not justified in such a stretch of power even although Mr. Clarke had knocked him down. As Mr. Clarke has since been frequently represented to me at Shoeburyness as a nuisance when there, I think it is not without reason that he regards himself as the victim of conspiracy and foul play. His parliamentary friends might with great propriety demand an official inquiry into the construction of the target, into the *animus* of the committees and the Shoeburyness officers, and into the results of the firing, which, I repeat, were as satisfactory as any that took place before, or any that have taken place since, structural weight being considered.

The Bellerophon Target,
8th December.

The Bellerophon target was the first official attempt at compound backing, and held by some to be an infringement of the Chalmers-Clarke systems. The assumption is true in a restricted sense only; the agreement with the Chalmers-Clark systems extending no further than to the separation of the backing into layers by iron stringers from the inner skin, to the outer edge of the backing. In other words the Admiralty, instead of bolting two layers of teak crossways on the skin of the ship, the skin had stringers or shelves riveted on it, and along those shelves the teak backing was secured. In other words, instead of the armour being supported by teak only, as in the Warrior, the armour of the Bellerophon was in addition supported by the flat of iron shelves. The change was not a very striking one, and its utility was not as fully tested as that of the other targets, the Admiralty being afraid to be over wise about the resisting qualities. The target, 20ft. 9in. by 8ft. 6in., represented a section of the ship between the main and lower

decks, and not a section in the line of ports. Its inner frame consisted of eleven vertical ribs 3 feet apart; each rib formed of an angle iron 10in. by $3\frac{1}{2}$ in., and two angle irons $3\frac{1}{2}$ in. by $3\frac{1}{2}$ in. by 5-8in. riveted on. The alternate ribs were fastened to the upper deck beams by a strong wrought-iron knee, and the end ribs were secured by knees connecting with the upper and lower deck beams. On the double angle iron ribs two thicknesses of $\frac{3}{4}$ in. plate with painted canvas between formed the skin; and the joints were covered by flat irons 6in. by $\frac{3}{4}$ in. On the iron skin, between the stringer shelves, 10 inches of teak were bolted; and on the teak two armour plates 6 inches thick. The target was the heaviest ever fired at, weighing 393lb. per square foot, without reckoning the knees and strengthening pieces behind the ribs, which increased the weight no less than $51\frac{1}{2}$ lb. The weight of the original Warrior target was only 335lb. in all.

The firing opened as usual with the test round from the 68-pounder and the 110-pounder, and these striking with a velocity of 1,405 to 1,468 feet per second, gave indentations of $1\frac{1}{4}$ to $1\frac{1}{2}$ inch. A salvo from two 68-pounders and two 110-pounders with shortened cylindrical shot of $66\frac{1}{2}$ lb. were next fired, the indentations ranging from $1\frac{1}{4}$ to $1\frac{3}{4}$ inch. A steel shell weighing 69lb., and containing a bursting charge of 2lb. 6oz. from the Whitworth $5\frac{1}{2}$ -in. gun, with a charge of 12lb., gave a striking velocity of 1,220 feet per second. The indentation was only 1.3-inch. A steel shell weighing 119lb., and containing a bursting charge of 2lb. 4oz., was fired from the Ordnance Select Committee 7.1-inch gun, with a charge of 16lb., and gave a striking velocity of 1,270 feet per second. The indentation was only 1 inch. A cast-iron shot, with a charge

of 35lb., fired from the 10½-inch 12-ton gun, obtained a penetration of 5 inches, cracked the plate in several places, and bulged the inner skin. A steel spherical shot weighing 165lb., from the same gun, with the same charge, passed through the armour and was buried in the backing; two bolts broken, one rib broken, and the skin cracked and bulged. A cylindrical 308lb. cast-iron shot from the same gun, with the same charge, obtained an indentation of 1·6-inch; bent and cracked the armour, and broke several bolts. Last of all a steel shell weighing 149½lb. was fired with a charge of 27lb. from the Whitworth 7-inch gun; bursting charge 5lb. 8oz., striking velocity 1,283 feet per second. On striking the target the damage was found to be considerable, eighteen inches square being carried away from the rear of the armour, two deck-knees started, and bolts and ribs broken. The general opinion was that a 300lb. steel shell with the usual bursting charge would have passed through the target and done great injury. But a 300lb. shell was not fired; therefore it was hoped the point would remain one of doubt. Moreover, to increase the doubt, the 10½-inch gun was only fired with 35lb. of powder; while 40lb. and 50lb. were the maximum charges against the Warrior, and 45lb. and 50lb. the maximum charges against the Chalmers target.

The Floating Warrior
Target, 11th December.

The floating Warrior target consisted of a raft some 36 feet by 40 feet, with the section of the ship mounted; the section 14 feet square strutted up behind in a most substantial manner. The programme was to obtain fair hits, first at 1,000 yards with the 600-pounder, and then fair hits with the 300-pounder; and afterwards to move the target out to 2,000 yards and obtain fair hits again with

both guns. To prevent shot being thrown away floating wood targets were moored at both ranges. The firing opened as intended, and the floating wood target was struck at the first round. The gun was then laid on the target, and after two misses a hit was obtained. The target was practically demolished by the one blow, a hole large enough for a full-sized man having been made through everything. Moreover, the structure was so twisted and shattered that on being brought to land repair was found to be impossible. Even the moorings were so disturbed that the raft shoved round so far as to render further hits impossible, although several times attempted, with the 300-pounder. Of course the practical destruction at 1,000 yards led to the abandonment of the firing at 2,000 yards. The steel shell which hit weighed 612lb., contained 24lb. powder, and was fired with a charge of 70lb. The elevation was 2 deg., and at 40 yards from the muzzle the velocity of the shell was 1,143 feet per second.

CHAPTER XVII.

EXPERIMENTS IN 1864.

Up to the Elbows.

The year 1864 opened with the committee up to the elbows with work, and their coats off. They were for the first time to try the 68-pounder with steel shot; they were to try the 600-pounder against an 11-inch plate; against the Warrior target on the marsh and against another floating target; they were to try the 13-inch mortars against the Scott Russell target; they were to put Mr. Nasmyth's wool-resisting theory to the test; they were to have another blow at the Chalmers target, and they were to try the Lord Warden and the La Gloire targets. But they were to try nothing of their own, and were still without opinions on the various questions which had so long occupied their attention. John Bull did not, however, grumble loudly; he rather felt proud in the possession of the committees, and was thankful for the crumbs of information which the press afforded him. It is to be hoped that his forbearance is at length at an end.

Steel 68-pounder shot,
8th January.

The long-deferred trial of steel shot for the 68-pounder took place at last. Two shot only were provided, and the firing

was preceded by a single test round of cast-iron, which gave the usual indentation of 2 inches on the Warrior target. The two rounds of steel gave the following results:—The first gave a measured penetration of 4 8-10-inches in the $4\frac{1}{2}$ -inch armour plate; the second gave a like penetration, sticking fast in the armour plate. In other words, the steel shot broke through the $4\frac{1}{4}$ -inch armour plate, while the cast-iron shot did not get half through. The range was the usual one of 200 yards, and the charge the usual one of 16lb. The steel shot were the manufacture of Messrs. John Brown and Co., Sheffield.

The 11-inch Armour,
10th March.

The 11-inch armour plate was a fragment of the great plate, rolled in the presence of the Admiralty at one of the John Brown celebrations. It measured only 3 feet 8 inches by 3 feet 4 inches, weighing 2 tons 8 cwt. It was supported at the two sides by timbers resting against an old target, the greater part of the plate unbacked. The gun employed was of course the 600-pounder, in position on the 200 yards' range, and the shot, a steel spherical one, weighing 344lb, with a charge of 90lb. The effects were an indentation of 4·9 inches, the breaking of the plate in two, and the parting of the halves some yards. People were annoyed. Those who before the firing confidently predicted that the shot would not only pass through the 11-inch plates but also through the $4\frac{1}{2}$ -inch plate and the iron frame behind, now exclaimed against the presentation of the plate, insisting that it should have been through bolted on seasoned oak, or set in a wrought-iron frame, and affirming that if either had been done, what they had said before would have been more than verified. The more philosophical remarked—

there are the results and there is the gun, and the 90lb. charge of powder: unquestionably the 11-inch plate has sustained the whole power of the gun and charge, and all the penetration is a hole 18 inches across by 4·9 inches deep. In other words, they said the 600-pounder is fairly beaten, and once more armour plates gain the day. On the other side, it was repeated the gun is beaten, because the 11-inch plate received the worst possible presentation to the gun. The velocities were—

At the muzzle, 1,760 feet per second.

At the plate, 1,680 feet per second.

The 13-inch Mortars,
10th March.

After the firing at the 11-inch plate, a 13-inch mortar was tried for direct fire and destructive effect against the Scott Russell target. The charge was 20lb., the cast-iron shot 280lb., the range 200 yards, and the elevation 2 deg. The first shot struck fair, inflicting considerably greater injury than the 68-pounder on the same target—a large piece of armour plate was broken away, a penetration of 6 inches obtained, one rib broken, another cracked, and the inner skin a good deal bulged. In other words, at 200 yards the 13-inch mortars would smash the Scott Russell target. The second shot missed, and the third was almost as destructive as the first. The velocities were—

At the muzzle, 790 feet per second.

At the target, 760 feet per second.

The 600-pounder and the
Box Target, 8th April.

On the occasion of the visit of His Royal Highness the Commander-in-Chief and the Secretary of State for War to witness the fifth day's firing of the Armstrong and Whitworth competitive guns, the 600-pounder was, by request, fired

against a strong box target that happened to be standing on the marsh. The skin and ribs were those of the Warrior, and the backing 12 inches of oak horizontally and 6 inches of teak vertically, and $6\frac{1}{2}$ -inch armour plates bolted on the backing. The weight was therefore greatly in excess of the Warrior, the excess with the timber being equal to 2 inches more armour. The gun was on the 200 yards' range, the steel shot weighed 612lb., the charge 70lb., and the shot passed easily through the structure, scattering enormous fragments. His Royal Highness the Duke of Cambridge entered the box, looked for a moment at the powdered mass of timber, and on coming out remarked to those about that in his opinion the gun would smash anything.

The Nasmyth Wool Target,
17th March.

The Nasmyth wool target was for the verification of the resistance of American cotton bales to shot—cotton being too dear to purchase, and the resistance of wool being supposed to be greater. A large boiler-plate caisson, some 8 feet or 10 feet in diameter, was closely packed with wool, and the wool afterwards pushed home by a wood frame-work worked by six powerful screws on the circumference. The squeezing was to obtain an approximation to the packing of American cotton bales, and that any imperfection in the squeezing might be made good by quantity, the thickness of the squeezed wool in the caisson was 11 feet. Great interest naturally attached to the firing, because the Americans have always taunted us with what cotton bales did against us at New Orleans in 1812, and in addition because the cotton bale defence theory has all along found many advocates among ourselves. Nay, more, many of the gun-boats on the Ohio and Mississippi rivers have had no other protection than

cotton bales, and on more than one occasion these have proved sufficient to protect ships and gunners from serious harm. How then our guns would deal with cotton bales has for some time been a great question, and on this occasion it was solved to the satisfaction of all present. The cotton-squeezed caisson was laid down endways to the gun-battery, so that the shot should enter at the mouth of the caisson, pass through the whole 11 feet of wool, and lodge in an earth embankment, should it eventually find its way out of the boiler-plate bottom of the caisson. The guns were a 68-pounder and a 7-inch or 110-pounder breech-loading Armstrong, with the ordinary service charges, at a range of 100 yards; and what was the result? Both shot passed through the 11 feet of wool, the bottom of the caisson, and 12 feet of solid earth besides. So much for cotton-bale defences against our guns, such as those guns are. Our guns really put shot through wool more easily than through earth, and, if cotton-bale defences beat American guns, why British guns will beat American guns as comfortably as General Jackson is said to have whipped us at New Orleans. As a matter of fact it may be well to add that the penetration of the 68-pounder was within one foot of the penetration of the 110-pounder into the solid earth, and that the 68-pound shot was two feet lower down than the Armstrong shot. Consequently, as a mere matter of fact inference, the penetration of both was alike; the greater resistance at the increased depth accounting for the one foot less penetration of the 68-pounder.

Shot at the Chalmers
Target, 5th May.

The Chalmers target, previously taken to pieces by dockyard shipwrights, and put together in comparative soundness again, was subjected to a single shot for a comparison

of its resistance with that of the Bellerophon. The shot was a spherical cast-iron one, fired with a reduced charge of 35lb. at 200 yards. On the Bellerophon the penetration had been 3·5 inches, and the penetration on the Chalmers target was found to be 3·3.

The Lord Warden Target. The trial of the Lord Warden took place on the 17th June. The target was the latest device of the Admiralty to keep out shot on the rather vulgar principle of piling-up material. Mr. E. J. Reed and Admiral Robinson, in devising it, may be conceived as saying, if two thicknesses of timber will not do behind the armour, let us try a third thickness. An Essex ploughman would have suggested the same thing, only he would probably have made sure by recommending two or three additional thicknesses instead of one. But the Constructor and the Comptroller of the Navy knew, what the Essex ploughman did not, that an additional thickness of timber involved an increase of weight likely to compromise the seaworthy qualities of any armour clad afloat. Still, in the Lord Warden target they risked another thickness; and that being a failure the ship must make the best of it. That is experimenting with a vengeance, in these vaunted days of scientific progress. No wonder, when such things are done, that Sir Frederick Smith seeks the appointment of a committee or the issue of a royal commission to inquire into the best modes of ship-building. The material entering into the construction of the Lord Warden represents a weight of hull, let us say, to put the matter clearly, twice as great as the weight of the Minotaur; therefore, to have a ship possessing the gun platform stability of the Minotaur, the Lord Warden ought to be twice the tonnage of the Minotaur. But suppose your ship is constructed half the

size of the Minotaur, then the Lord Warden, as regards gun-platform stability, will only be half as good a ship as the Minotaur. In other words, a Lord Warden half the size of the Minotaur would plunge and roll about at sea to an extent that in very moderate weather would render the guns completely useless, and a Lord Warden twice the size of the Minotaur would be almost as unmanageable and useless as the Great Eastern. Then a Lord Warden of the same proportions as the Minotaur would be all the additional weight the worse ship of the two. Ships, the advisers of the Admiralty appear to forget, are floating bodies, capable of sustaining given weights advantageously or disadvantageously; for by the mere addition of weight you may sink ships altogether. Whatever the shot-resisting power of the Lord Warden, the ship will necessarily be one of the most unmanageable and costly, as well as one of the most worthless, in the navy, for general service on foreign stations. The weight of the section of the Lord Warden fired at on the occasion was 400lb. per square foot. The official description is that of a target 20 feet by 9 feet, representing the ordinary construction of a wood armour clad ship, with the addition of a skin outside the frame of the ship. The scantlings are—frame timber moulded, $12\frac{1}{2}$ inches; iron diagonal sides, connecting the frame timbers, 6 inches by $1\frac{1}{4}$ inches; inner planking, 8 inches thick; iron skin, $1\frac{1}{2}$ inch thick; outside planking, 10 inches thick; rolled armour plates, $4\frac{1}{2}$ inches thick. These scantlings were through-bolted, with bolts of $2\frac{1}{2}$ inches diameter. Then in the rear of the target there were the deck beams—lower 15 inches by 12 inches; upper 16 inches by 16 inches; waterway, lower, 15 inches by 15 inches; upper, 13 inches by 14 inches; deck planking, lower, 4 inches; upper, 4 inches. In a word, the target was a perfect

section of the ship now building, with lower deck and upper deck, lower beams and upper beams, &c.

The firing opened with the 68-pounder at 200 yards.

THE FIRST ROUND.

Service 68-pounder, steel shot, 16lb. charge. The shot produced an indentation of 3·6 inches, striking the head of an armour bolt, and starting a bolt in the rear. No one on board the ship would have been injured; therefore the Lord Warden may be said to be proof against the 68-pounder fired, not with cast-iron shot, but with steel shot. The velocity of the shot was 1,500 feet per second.

THE SECOND ROUND.

Somerset, 9·22-inch $6\frac{1}{2}$ -ton gun, steel round shot, weighing 100lb.; charge, 25lb. The shot struck at the waterways, where the target presented an aggregate thickness of $42\frac{1}{2}$ inches, passed through the outer armour plate, and embedded itself in the backing. The waterway, 15-inch by 15-inch beam, was cracked through, but there was no splinters. This was a shot in the strongest part of the ship, and showed that a ship of even $42\frac{1}{2}$ inches thick would in time be smashed by the $6\frac{1}{2}$ -ton 9·22-inch Somerset. The velocity of the shot was 1,540 feet per second.

THE THIRD ROUND.

Somerset, 9·22-inch $6\frac{1}{2}$ -ton gun, steel shell, weighing empty 171lb.; charge, 20lb.; and bursting charge, 7lb. The effect was not much greater than before, the outer plate being passed, the woodwork cracked right through, and the armour plates started. Beyond starting the armour plates the shell effect was nothing; no setting fire. The fire of the shell and the fragments darted straight from the target towards the battery. The velocity of the shell was 1,200 feet per second.

THE FOURTH ROUND.

Frederick, 7-inch, $6\frac{1}{2}$ -ton gun, steel shot, weighing 100lb.; charge, 25lb. The shot struck near the top of the target, and being repelled by the inner armour plate after going through the first, dislodged the outer thickness of timber, and escaped seaward. As the competing Somerset had passed beyond where the Frederick had been stopped the Somerset consequently proved the better gun. The Somerset made the larger hole, the hole of the 9·22 inches against the 7 inches, with the same charge of powder, and exhibited the greater penetrative

power. In other words, the large bore beat the small bore with the same charge and the same weight of gun. The upper deck beam was now started. The velocity of the shot was 1,560 feet per second.

THE FIFTH ROUND.

Armstrong, $11\frac{3}{4}$ -ton, 10·5-inch gun, 150lb. steel round shot ; charge, 50lb. The shot was buried in the backing, knocking out the inside planking considerably, but not to the extent of occasioning serious casualty from splinters. The velocity of the shot was 1,690 feet per second.

THE SIXTH ROUND.

Anderson gun factory, $12\frac{1}{8}$ -ton, 9·22-inch gun, 220lb. steel shot ; charge, 44lb. This shot passed right through the target, but at its weakest part—namely, on the top of the shelf below the upper deck beam, where the thickness is only $27\frac{1}{2}$ inches instead of $37\frac{1}{2}$ inches and $42\frac{1}{2}$ inches elsewhere. Such a result was necessarily unsatisfactory to every one, and there were whispered charges of unfair marking for the firing. The velocity of the shot was 1,460 feet per second.

THE SEVENTH ROUND.

Somerset, 9·22-inch, $6\frac{1}{2}$ ton gun, 168lb. chilled cast-iron shot ; charge, 25lb. The shot passed through the outer armour plate, shaking the target well behind, but without splinters. As a cast-iron shot this was a great success. The velocity of the shot was 1,540 feet per second.

THE EIGHTH ROUND.

Anderson gun factory, $12\frac{1}{8}$ -ton gun, 221lb. steel shot ; charge 30lb. This shot was fired low and grazed the ground in front, passing through the outer plate at the bottom. Practically the shot was thrown away. The velocity of the shot was 1,260 feet per second.

THE NINTH ROUND.

Armstrong, $11\frac{3}{4}$ tons, 10·5-inch gun, 301lb. steel shot ; charge 45lb. This was a most destructive shot, passing right through the whole structure, filling the deck with heavy splinters, and throwing an iron knee of 3cwt. 2qr. 21lb. a distance of 20 yards. The shot, after passing through the target, struck an immense granite block and broke into four pieces, one of the pieces bounding off a further distance of 50 yards. The victory of the gun was perfect, a single round or two of the 300-pounder shunt Armstrong being sufficient to consign the Lord Warden to the bottom. And such a hole ! plugging or stopping an impossibility by any means.

THE TENTH ROUND.

Anderson gun factory, $12\frac{1}{8}$ tons, 9-22-inch gun, 221lb. steel shot; charge, 30lb. This shot passed partially through the hole made in the sixth round, went clear through the structure, filling the deck and back ground with heavy splinters. Another victory for the guns, but a defeat for the small-bore as against the 10-5-inch guns.

THE ELEVENTH ROUND.

Somerset, 9-22-inch, $6\frac{1}{2}$ -ton gun, 171lb. steel shell, bursting charge, 7lb.; charge, 20lb. Shell struck a previous hole, tearing away another iron knee to the distance of 17 yards in passing through. Timber set on fire, but extinguished by two pails of water.

THE TWELFTH ROUND.

Anderson gun factory, $12\frac{1}{8}$ tons, 9-22-inch gun, steel shot of 222lb.; charge, 30lb. Shot passed through the structure practically, completing the general wreck of the Lord Warden target.

THE THIRTEENTH ROUND.

The thirteenth and last round in the state of the target is scarcely worth recording. The shot was a chilled cast-iron one weighing 105lb., fired with 20lb. of powder.

The La Gloire Target,
4th August.

The famous La Gloire target passed the Shoeburyness ordeal on the 4th August. Why the old-fashioned guns enjoyed the privilege, to the exclusion of the great modern guns, is explained by the desire of the authorities, or those acting for the authorities, to possess comparative results with the old-fashioned ordnance. Had the section of La Gloire been mounted on a dockyard barge, or on a gun-boat moored at 2,000 or 3,000 yards, and fired at with the 300 and 600-pounders, the results would have possessed no interest, but proved irregular and annoying to those who for years past have been hammering away with 12lb. and 16lb. charges, and trying to persuade themselves and others that, after all, the 68-pounder is the best gun we have. To the army and the navy, and an intelligent public, the results, however, would have been

interesting and instructive ; nay, they would have been well-timed and proper. But does it not also stand in need of explanation, that whereas *La Gloire*, French iron clad, was launched in 1860, the first target section of that ship was only fired at in this country on the 4th August, 1864. Notwithstanding all the Parliamentary assurances of Lord Clarence Paget that we were on the best terms with France, and that he knew everything that was going on in the French dockyards, four years after *La Gloire* has been launched the drawings of the ship found their way to England. And I am bound to state that the *La Gloire* fired at at Shoeburyness is a very different structure from *La Gloire* of 1864 in France. The modern *La Gloire* is a ship with some three inches of protruding armour at the load line, while the Shoeburyness target has a protrusion of one inch only. Then the French have given great attention to the choice of timber on which to hang their armour plates, while the Admiralty have left the choice to Mr. E. J. Reed and Mr. Bascombe. Last of all the modern *La Gloire* has bolts of a different pattern and greater length ; the length ranging from 20 to 24 inches ; and the thread of the bolt is deeper and narrower at the base. These, however, are small matters, because it is now admitted, both in France and England, to be impossible to construct a target or a ship that will keep out the shot of large calibres. The guns not only now have it in France and England, but, what is scarcely less important, the contest practically is closed and a change of natural laws is a condition of its being resumed.

The target, like all the French ones, is faced with small plates ; the plates of the two upper rows being 5·9 by 2·7, and the plates of the two lower rows being 5·9 by 2·5. These are small dimensions, and it is a

point on which no opinion need be offered in this place, whether the French small plate or the English large plates are the better. The plates of the section of the *La Gloire* fired at were of the usual French size, but the manufacture of the Millwall Iron Works, Millwall. They were in four strakes or rows, presenting an aggregate area or face of 17 feet 2 inches by 10 feet. Immediately behind the face of the target were three layers of oak, forming the backing—two horizontal and one vertical; the solid frame timbers 11 inches thick, the inner skin 6 inches thick, and the outside planking 10 inches thick. Altogether, irrespective of deck beams, deck knees, waterways, and deck planking, there was a backing of 27 inches of solid oak, faced on the load line with two strakes or rows of armour 5·9 inches thick, and above the load-line with two strakes or rows of armour 4·75 inches thick. In the rear of the 27 inches of solid oak backing there were 5 wood knees, braced with iron on both sides; each wood knee being 50 inches in height, 24 inches in breadth, with a thickness of 15 inches. On the top of these wood knees were the beams and upper deck; the wood knees separated by a thick shelf. Then, last of all, the gun-deck portion of the target had its heavy waterways, and deck, and beams; the whole target supported in the rear by five great uprights, with five slanting and five base supports; all in a line with the wood knees. Such was the target and its supports; the total weight of the target proper being 28 tons 3cwt. 2qr. 13lb.

The programme for the rounds at the 200 yards' range on the marsh was as follows:—

AT THE 4·75-INCH PLATES.

Round No. 1.—68-pounder, smooth-bore gun; cast-iron spherical shot, 66lb. weight; charge 16lb.

Round No. 2.—7-inch Armstrong breech-loading rifled gun ; cast-iron cylindrical solid shot, 110lb. weight ; charge 12lb.

Round No. 3.—68-pounder smooth-bore gun ; steel spherical solid shot, 70lb. weight ; charge 16lb.

Round No. 4.—7-inch Armstrong breech-loading rifled gun ; steel cylindrical solid shot, 110lb. weight ; charge 12lb.

Round No. 5.—9·22-inch Armstrong shunt muzzle-loader ; 222lb. cylindrical steel shot ; charge 30lb.

Round No. 6.—9·22-inch Armstrong shunt muzzle-loader ; 220lb. cylindrical chilled cast-iron shot ; charge 44lb.

AT THE 5·9-INCH PLATES.

Round No. 1.—68-pounder smooth-bore gun ; cast-iron spherical solid shot, 66lb. weight ; charge 16lb.

Round No. 2.—7-inch Armstrong breech-loading rifled gun ; cast-iron cylindrical solid shot, 110lb. weight ; charge 12lb.

Round No. 3.—68-pounder smooth-bore gun ; steel spherical solid shot, 70lb. weight ; charge 16lb.

Round No. 4.—7-inch Armstrong breech-loading rifled gun ; steel cylindrical solid shot, 110lb. weight ; charge 12lb.

Round No. 5.—9·22-inch Armstrong shunt muzzle-loader ; steel spherical solid shot, 168lb. weight ; charge $22\frac{1}{2}$ lb.

Round No. 6.—9·22-inch Armstrong shunt muzzle-loader ; Captain Palliser's chilled cast-iron cylindrical shot (hollow) ; charge 44lb.

The general result of the firing is sufficiently embraced in the firing at the 4·75-inch plate. The first shot struck the corner of the plate with the usual penetration, leaving the backing uninjured. The second shot gave a slighter indentation. The third shot gave the greatest penetration of the three ; but still leaving the woodwork of the target practically uninjured. The fourth shot stuck in the armour plate, not doing further mischief. The fifth shot—Captain Palliser's—passed through the target, carrying one of the wood knees some yards with it. The sixth and last of the rounds passed also through the target, making an ugly hole in the backing. Thus the target was practically destroyed by the old-fashioned guns and

the old-fashioned charges. A single blow from the 300-pounder, not to speak of the 600-pounder, would have been as ruinous as for the Lord Warden, the Bellerophon, or the Chalmers. Nor would the French system of screw-bolting into the frame timbers have saved the target from the modern guns, although it must be confessed that the bolts driven through the target were fine specimens of French manufacture.

The last Floating Trial of the 600-pounder, August.

The 600-pounder, for the last time afloat before removal, was fired in the presence of the members of the ex-Royal family of France and suite at a floating Warrior target, brought over from Sheerness Dockyard for the purpose. Originally it was intended that the target should be fired at from 2,000 yards, the distance between the new Spithead Forts, but the committee moored the target at 500 yards, and reduced the charge of powder from 70lb. to $51\frac{1}{2}$ lb. to represent the effect at 2,000 yards. In front of the target, on the bank, stood the great gun—the only one yet possessed by the country; and the programme of the day was as follows:—

1. The iron target to be moored at 500 yards from the battery, where the 13·3-inch gun is mounted.
2. A common wood target to be moored at the same distance, but just clear of the iron one.
3. Fire one or more of the cast-iron shells (same shape and size, and brought up to the same weight, 612lb., as the steel shells) at the wooden target as pilots to ascertain the correct elevation.
4. With the elevation thus obtained fire steel shell with 24lb. bursting charge until one good hit has been obtained; charge, $51\frac{1}{2}$ lb.

The first shell missed the target, but penetrated the wood framework, making two inconsiderable holes. The second shell grazed the head of the upper armour plate,

bursting in the wood framework, a large portion of which went into the air in a shower. The third shell, too low for the target, struck the sea in front, and ricochetting, struck the upper armour plate, passing through it and the backing, practically demolishing the target. Boats immediately proceeded from the beach, and on the dummy being reached it was apparent that all that had been said hitherto of the superiority of the guns over armour plates was confirmed. The upper armour plate had dropped from the target with every bolt broken, the backing was penetrated, one of the rear supports injured, and that portion of the dummy which would represent the deck was more or less covered with bolt heads and splinters. In a word, the third shell would have arrested the progress of any iron clad afloat, assuming such iron clad to have been forcing the Spithead or the Needles passage at 2,000 yards. Not a man would have survived at the guns, and a very ugly hole for stopping would have presented itself in any iron-clad's side. What the effect of the shell would have been had there been no previous ricochet before striking the target it is impossible to say. Probably the whole wood-backing of the target would have been destroyed, and no doubt the third as well as the second armour plate would have been started.

After the firing of the third shell it was found impossible to strike the target fairly, the low charge at which the gun was fired rendering the shooting of the gun somewhat wild. The fourth shell missed the target, and passed to the left through the framework. The fifth shell fared no better, passing above the target, and through the ruins of the previously demolished framework. And with the fifth shell the firing at the target ended, all present being once more satisfied that the

guns have it. On the ground it was stated that the Admiralty have at length laid their account with the absolute vulnerability of any target that they can produce. In the presence of such guns as the 600-pounder armour plating is of no avail, and the latest change of Mr. E. J. Reed is said to be in the direction of a mere belt of armour round the water-line. This is the reason why the Lord Warden target has been withdrawn, it being found impossible to devise any combination of wood and iron that will resist shot from large guns. Eventually, no doubt, armour plating, now restricted to the water-line, will be discarded altogether, and the future problem will be the means of letting shot and shell pass through and through a ship's side with the minimum of effect to the ship and those on board.*

* Mr. Alexander, C.E., in the employment of the Millwall Iron Works, has recently submitted to the Admiralty the best submarine battery that I have seen. It is for the destruction of iron clads at long range, by submarine rockets. The utility of the invention may be at once tested at a public outlay of only £100.

THE PROJECTILES.

CHAPTER XVIII.

PROJECTILES.

The State of the Question. The question of projectiles could not possibly be in a worse state than it is at present. We are without projectiles, because the official mind has not yet decided about guns ; and as projectiles will not be thought of seriously until the gun difficulty is got over, it is impossible to foresee when the question of projectiles will begin or end. When the question of projectiles comes to be considered, a wide sensation field will be opened to inventors, aspiring officers, and the newspapers. As a tallow candle may be fired through an inch board, perhaps the useful dog-feed of chandlers will yet become famous. The properties of tallow shot and shell would bring into requisition much of the peculiar knowledge of sailors who have served in the Brazils, and of soldiers who have partaken of a New Zealand barbacue:—

Oldfield, with more than harpy throat endued,
Cries, "Lend me, gods, a whole hog barbacued."

Those learned in tallow tell on the instant by the touch what the feed has been, whether on beech nuts in the bush, or on wheat or barley in the stall; and although *the fumes of burning tallow are, as a rule, gracious, there are no doubt many more varieties of the smell than there are kinds of guns or rifling. The *savants* of both services, and of the institution in Whitehall-yard, have a good time before them; even although tallow shot and shell are not resorted to. In answer to formal inquiries, I am assured by those great manufacturers* on whom the country must rely when the day of pressure comes, that of modern projectile-making they as yet know nothing, or next to nothing. They are devoid, or practically devoid, of experimental knowledge. Once or twice their shot may have been tried at Shoeburyness, but as a skilful iron worker may turn out shot which are hard, soft, or intermediate, a long course of experimenting may be necessary to hit upon the right quality.† It is with shot as with Colonel Boxer's fuzes—no effort should be wanting to attain perfection by weekly, if not by daily, trials. All that any gun or any gunpowder can do for projectiles is to give them motion through the air; but, no matter what the velocity of a badly made shot or shell, it will break to atoms on an armour plate, and in proportion to the goodness of a shot or shell will its destructive effect be measured. Good projectiles are therefore in truth a greater desideratum than good guns; because an indifferent gun discharging a good

* The peculiar fame of Mr. Whitworth is greatly owing to the experimental facilities extended to him from the public purse. Such practical iron men as Mr. Hughes of the Millwall Iron Works, and Mr. Clay of the Mersey Iron Works, would have accomplished much more than Mr. Whitworth with much less money.

† The reader is not to generalise this statement; shot experiments are alone recommended.

shot or shell may accomplish much, while a good gun discharging a bad projectile may accomplish nothing. Why the consideration of projectiles has been subordinated to the consideration of guns, and, indeed, lost sight of altogether, need not be inquired into. It is enough for our present purpose that the production of modern projectiles is probably more in arrear in England than anywhere else in Europe; because the authorities have restrained the manufacturers. Instead of offering inducements to the manufacturers to send all the shot they liked, to be fired when they liked, from the experimental batteries at Shoeburyness, Lord De Grey has treated several of the manufacturers with great unkindness. Some have sent their shot to Woolwich through the circumlocution office; and at Woolwich it has been kept for months. Some have had one trial of shot in three years; although encouraged by officials to erect furnaces and rolling mills for the production of shot. Lord De Grey will answer that until the calibres of the service guns were fixed shot could not be produced; but had the manufacturers been allowed to perfect shot and shell for a 7 or 8 inch gun, it would afterwards have been easy for them to turn out any size of shot. My belief is that at the present time (March, 1865) there is not in the national arsenals sufficient 10·5-inch and 13·3-inch shot, shell, or ammunition to fight a general action in the Channel, or to reduce a single third-rate fort.

What is Wanted.

What is wanted above all things in projectiles is readiness of production, combined with the most essential qualities. We stand in need of cast shot of any degree of hardness and cohesion which may be required; shot which will admit of transfer from the common foundry mould to the arsenal and the battery.

Such shot might be produced, and would admit of production to an extent equal to any possible emergency, and at a moderate cost, while shot that stood in need of turning or planing could not be supplied rapidly, nor at a moderate price. For some months past cast shot of this kind have been in readiness at Woolwich for trial at Shoeburyness; some of them so hard, it is said, as to defy the lathes and planing machines of the Royal Arsenal; others so soft as to admit of easy turning or planing. The iron-steel sand of this promising shot exists in great abundance in the vicinity of Naples, and the concessionnaires are Englishmen; one of the two being Mr. Jacob Elkin, Windsor Chambers, Great Saint Helen's. Upon the sand, I am told, extensive works are erected for the manufacture of shot, and one or more furnaces are said to be in operation in this country. With a certain mixture of ordinary English ore the iron-steel may be cast of any hardness, and it is understood to enter extensively into the manufacture of the large guns which recently stood so well at the butts and have been sent abroad. The best iron-steel shot admit of production in this country with a good manufacturer's profit at £20 a ton, against inferior Sheffield steel shot at prices varying from £30 to £40 a ton; and the production on the spot for the Italian, Turkish, and French, and other governments, would obviously be minus the difference between the cheap labour of Italy and the dear labour of this country, together with the difference in transport, which last is an important item, especially as regards the manufacturing waste. Whether the concessionnaires are or are not full handed with continental shot contracts I am not aware, but no doubt Lord De Grey knows. Perhaps the delay in the trial of the shot at Shoeburyness is owing to the sharpness of our conti-

mental neighbours, in for a long time closing against us a supply, which it is well known Lord De Grey has had pro-offered to him. If so, Lord De Grey may yet have reason to lament the wretched official system which he controls, inasmuch as it would have for a time wrested from him that which, so far as he is concerned, remains untried.

The Abstractions of the Subject.

Into the abstractions of the subject there is no occasion for me to enter: into the laws of projection, atmospheric resistance, and gravitation. With those laws the artillerist has alone to do, and it is to their appropriation by others that the subject is at all obscure. Philosophically speaking, the effects of projectiles are alone material; just as in the matter of a pair of boots a comfortable fit is requisite, not dissertations on the chemical profundities of the quick and slow tanning processes. The laws of projectiles, like all other laws, are the refuge of ignorance and pretension; and as in medicine ignorance and pretension cannot now-a-days practise imposition by unintelligible references to affections of the nerves and depressions of the animal spirits, the sooner that projectiles are spoken of in a matter-of-sense sort of way the better will it be for economy and truth. When an officer or a man speaks of projectiles, of targets, or of guns in lofty, unmeaning terms, he should be at once suspected, and, by way of punishment, required either to confess his ignorance, or to state precisely what he means.

CHAPTER XIX.

SHOT COMPETITIONS.

The trial of the 24th
March, 1864.

As there has been only one important trial of shot, that at which I was present on the 24th March, 1864, I cannot do better than reproduce my report.

The steel-shot experiments at Shoeburyness yesterday were of great practical utility, as well as of considerable scientific value. The practical point intended was to ascertain, in a fair and impartial manner, who are the best makers of steel shots, so that the national arsenals may be from time to time replenished from the open market of the country with the best article that can possibly be obtained. For this purpose the steel-shot makers sent in 126 rounds in all, and some of them were represented at the trials, and some were not. To the absent ones we are bound to state that the conditions were unexceptionably equal, and that from beginning to end there was not displayed the faintest shadow of partiality. The members of the ordnance select committee and of the special committee on iron, after expressing themselves pleased with the efficient and inexpensive way in which the ten targets had been erected by Captain Inglis, left the matter in the hands of

the Shoeburyness officers, and betook themselves to the friendly shelter of the Warrior and Mr. Scott Russell's targets. Unvaried 12lb. charges of powder then found their way into the battery of the 7-inch breech-loading Armstrong guns—the 110-pounder—and the sample steel shot was piled behind. Still, there may have been some non-contents present, and if there were, then it must be said that disappointment is not easily borne with equanimity, and that Shoeburyness is a disgusting place to most experimentalists. But what were the conditions of the trials apart from the 12lb. charges, the Armstrong guns, and a 200 yards range? The separate targets, each 7 feet by 3 feet 6 inches, were provided, each forming a separate rolled armour plate from the Millwall Works, and each $5\frac{1}{2}$ inches thick. These armour plates were placed erect on stout wood foundations in the same manner as the 11-inch plate for the 600-pounder, and kept in their places against 12 by 12 uprights and 12 by 12 back supports by front ties of railway iron. To each armour plate there were two such railway ties, two such back supports, and two such uprights, with cross beams binding the whole together. Last of all, for more effectual resistance to the impact of the shot, each of the back supports rested upon and was held in its place by a thick 12 by 12 post well sunk into the ground. These were the other conditions of the trials. There was besides, however, a single negative condition, as in the case of the 11-inch plate target—that, namely, of there being nothing behind the bodies of the armour plates, the 12 by 12 wood uprights only, backing up the edges from top to bottom. From this repetition of all that was distinctive in the trial of the 11-inch plate some scientific considerations were in the course of the firing brought to light. In the first place, it was discovered

that this unbacked or naked presentation of the armour plate admitted of perfect penetration; so that we are now warranted in stating that the second trial of the 600-pounder was a real failure. With the penetration of the 11-inch plate the presentation had nothing at all to do, and the most therefore that can now be said in favour of the 600-pounder on the second trial is that if the shot had been manufactured at the Atlas Works, Sheffield, instead of by Sir William Armstrong, it is not improbable that the 11-inch plate would have been penetrated. In the second place, rolled armour plates fired at with naked presentation do not stand well. The rolled weldings that go to form the thickness of the plates do not stick together, and no matter whether a shot goes through or not the plates are practically, if not irreparably, destroyed. Where, for example, there is an indent of two or four inches, there is an ugly blister in the rear, with one or two of the rolled thicknesses partially if not completely broken off. Where, again, there is perfect penetration; a circle of a diameter equal to twice or thrice the diameter of the shot, falls out in the rear; that is to say, the whole surface that has borne the impact of the shot drops off on the other side to the extent of one or two of the rolled thicknesses that go to form the thickness of the plate. Were it a question—which it certainly is not—whether wood backing should or should not be employed, it might, from the demonstrations of yesterday, be asserted with perfect truth that hammered armour plates are to be preferred to rolled plates. No doubt the backing gives to rolled plates all the cohesion and strength that can reasonably be expected from any armour.

But passing next to the firing of the various rounds

and their effects. The first round, from three Armstrong guns, fired rapidly in succession, was directed against a plate for the Messrs. Attwood and Co., a plate for the Bolton Iron and Steel Company, and a plate for Messrs. John Brown and Co., Sheffield. The Attwood shot stuck hard and fast in the Attwood plate, knocking out the back thicknesses of the plate, which in turn tore away a portion of the wood upright. The Bolton shot, indenting the Bolton plate, fell in front, somewhat thickened and cracked, leaving in the rear a bulge and cracks. The Brown shot struck the lower left-hand corner of the Brown plate-going through, destroying one of the tie railway bars, as well as an upright, and upsetting the plate, which thereby was rendered useless for further firing. The second round from the same guns, fired simultaneously, was directed against a plate for Messrs. Bessemer and Co., a plate for Messrs. Butcher and Co., and a plate for the Mersey Iron Works, Liverpool. All three shots were repelled, and lay in front of the plates, and all three plates were more or less bulged out behind as in the other cases, with the rolled weldings severed. The third round from the same guns fired again simultaneously was directed against a plate for the Messrs. Parry and Co., a plate for the Messrs. Sanderson Brothers, and another plate, which was missed. Of the two shots the Messrs. Sanderson's stuck fast in the plate, and that of the Messrs. Parry broke on the plate, a part sticking in and a part smashed in front, bulges and severances of the rolled weldings behind. The fourth round from the same guns, fired again simultaneously, was directed against the Attwood plate, the Bolton plate, and a new plate for Brown. Attwood's shot stuck fast as before, the Bolton shot, repelled, fell in front as before, and the Brown shot went clean through the plate

and buried itself some feet deep in the bank behind. The same destruction of the rolled weldings behind was repeated in each of the cases. The fifth round from the same guns, fired again simultaneously, was directed against the Mersey plate, the Butcher plate, and the Bessemer plate. The Bessemer shot stuck fast in the plate, and the two others, repelled, lay in front. The same destruction behind was repeated. The sixth round from the same guns, fired again simultaneously, was directed against the Sanderson plate, the Parry plate, and the Brown plate. The Parry shot passed through the plate near the edge, breaking up and destroying an upright. The Sanderson shot failed to stick in the plate as before and lay in front. The Brown shot passed clean through the plate as before, carrying a massive portion of the woodwork with it, and actually dislodging the previous shot from the embankment. Just before the firing of the round workmen were engaged digging out the first shot, and on their return from the splinter-proof, after the "cease-firing" had been sounded, the massive woodwork of the other shot was buried where they had been standing previously. The seventh round was varied to this extent—that the Butcher plate was fired at with a Parry shot, and the Mersey plate fired at with a Brown shot. The third shot was an Attwood. Through the Mersey plate the Brown shot passed; the Butcher shot broke on the plate, scattering fragments; and the Attwood shot, repelled, lay in front. The eighth round, with one gun only, was a trial at the reduced 10lb. charge with a Brown shot, which, if penetration had been obtained, would have proved that penetration would have been certain at 600 yards with the 12lb. charge. The penetration obtained was only 2·3 inches.

After the firing ceased, we took the following sum-

mary, measuring roughly for approximate results, the implements of exact indentation measuring not being possessed by members of the press. On the face of the Attwood target two shots stuck fast, and the third shot gave an indentation of $4\frac{1}{2}$ inches. In the rear the heads of the stuck shot were seen, but the repelled shot did not penetrate so far. There was a large rear circle of fallen-out iron where each shot had struck. On the face of Bessemer target one shot stuck fast, and the second gave an indentation of 2 inches. The rear of the target suffered like the other. On the face of the Parry target there was a hole on the edge, and an indentation lower down of 8 inches. The rear of the target damaged as before. On the face of the Bolton target there were two indentations of 3 inches. The rear of the target damaged as before. On the face of the Butcher target there were two indentations of 4 inches. The rear of the target damaged as before. On the face of the Sanderson target there was a shot stuck fast and an indentation of four inches. The rear of the target damaged as before. On the face of the first Brown target there was the first hole. On the face of the Mersey target there was the hole from the Brown shot and two indentations of 2 inches. The rear of the target damaged as before. On the face of the second Brown target there was the second hole. The guns throughout were fired by Lieutenant Noble, R.A., in an adjoining bomb-proof with the electro-magnetic exploder. This valuable instrument, which admits of firing either in succession or in combination simultaneously, is the invention of Wheatstone. The tubes, without which the instrument would be comparatively useless, are the invention of Mr. Abel, the chemist of the War Department.

Mr. Bessemer's Letter to
the *Times*.

A portion of a long letter written by Mr. Bessemer on the subject of spherical steel shot, is deserving of preservation. Mr. Bessemer says—

“It is now just three years since I obtained a patent for producing cast-steel spherical shot by a peculiar arrangement of the rolling mill, by means of which spherical steel shots may be made with rapidity and correctness. I also exhibited a spherical steel cannon-ball at the International Exhibition in 1862, for the purpose of giving further publicity to my views on this important question ; but it is only after this lapse of time that a trial is made of them in England, although a delay of ten or twelve days and an expenditure of £50 would have given as full a proof of their efficiency three years ago as we have to-day. Meanwhile, however, many hundred thousand pounds have been expended in building iron-plated ships which these long-neglected steel projectiles will riddle as easily as the cast-iron shot found its way through the wooden walls of our old men-of-war. It is marvellous how the advantages of using such a material for projectiles did not force itself on the attention of every practical artillerist, irrespective of any efforts on my part, for there is scarce a schoolboy to be found who does not know that a snowball flung with great force is perfectly harmless, while a stone or other solid substance of equal weight would inflict a severe injury, simply because the snowball will fall to pieces on striking the object, while the stone would remain entire, and consequently administer the whole force with which it was thrown. Now, the way in which a cast-iron shot is broken and scattered in a shower of small fragments on striking an armour plate bears a very strong analogy to the snowball in the case supposed. Indeed, it must be obvious to every mechanical mind that when a cast-iron shot is shivered to atoms against an armour plate, the force expended in the disintegration of the solid spherical mass must be considerable ; and it is equally clear that the force so expended is not a new force created for that especial purpose, but is part of the original force imparted to the shot, and that the amount of force so expended on the shot must consequently be deducted from the available force to be expended on the armour plate, and hence the great inferiority of cast-iron as compared with steel shots, since the latter are not crushed by the force of the blow.

A P P E N D I X.

(A.)

RETURN of the various COMMITTEES appointed to inquire and report on the System proposed by MR. WHITWORTH to be adopted in FIRE ARMS.

March 1854 — Mr. Whitworth proposed to undertake a series of experiments, with a view to securing by the help of machinery, the greatest possible exactitude in the manufacture of rifle barrels.

January 1855 — A Committee was formed, consisting of—

Mr. Whitworth.

Captain Jervis, R.A.

Lieutenant Lutyens, 20 Regiment.

Mr. Wesley Richards.

Captain (now Colonel) Dixon succeeded Jervis, and Captain (now Lieutenant Colonel) Younghusband replaced Lieutenant Lutyens.

January 1856 — The subject of guns rifled on Mr. Whitworth's system was before the Ordnance Select Committee from January 1856 until the formation of the "Special Committee on Rifled Cannon" in September 1858.

In 1856, the Ordnance Select Committee consisted of—

President :

Major General W. Cator, C.B., Director
General of Artillery.

Vice-President :

January 1856 — Captain J. C. Caffin, C.B., Naval Director
General of Artillery.

Members :

Colonel R. Hardinge, K.H., R.A., afterwards
succeeded by Colonel W. B. Gardner, R.A.
Colonel P. Cole, R.E., afterwards succeeded
by Lieutenant Colonel Walpole, R.E.
Colonel A. Tulloh, R.A.
Lieutenant Colonel W. H. Askwith, R.A.
Lieutenant Colonel F. Eardley Wilmot, R.A.
Lieutenant Colonel W. M. Dixon, R.A.
Captain P. J. Bainbrigge, R.E.
Captain C. W. Younghusband, R.A., F.R.S.
Captain E. M. Boxer, R.A.
Captain C. F. Young, R.A.
Professor Sylvester, F.R.S.
F. A. Abel, Esq.
J. Anderson, Esq.

Associate Members :

Professor Wheatstone, F.R.S.
C. H. Gregory, Esq.

Secretary :

Colonel Pickering, R.A.

Assistant Secretary :

Captain F. A. Campbell, R.A.

July 1856 — A Sub-Committee of the Ordnance Select Committee was appointed, consisting of—

Lieutenant Colonel F. Eardley Wilmot, R.A.
Captain Younghusband, R.A.
Captain Boxer, R.A.
Mr. Burton.

With whom the following officers were associated :—

Lieutenant Colonel Lefroy, R.A.
Captain Warlow, R.A.
Mr. Penn, C.E., F.R.S.
Mr. Anderson.

Their instructions were to “enter fully into the narrative of Mr. Whitworth’s proceedings, to ascertain the expenses charged or chargeable to the

public for them, and to detail the conclusions deducible from them."

11 June 1857 — A new Committee was appointed, consisting of:—
 Sir W. Codrington, President (succeeded by
 Colonel Hutchinson in June 1858).
 Colonel Hay.
 Colonel Gordon.
 Lieutenant Colonel Hudson.
 Lieutenant Colonel Dixon, R.A.
 Captain Boxer, R.A.
 Mr. Whitworth.

The Commander in Chief, and Secretary of State
 for War being *ex officio* members.

[Dissolved, March 1859.

May 1858 — A special Committee was appointed to enquire into
 Mr. Whitworth's expenditure on account of ex-
 periments, consisting of—
 Colonel Hutchinson (President of the Small
 Arms Committee).
 Captain Warlow.
 Mr. Anderson.

September 1858—The "Special Committee on Rifled Cannon" con-
 sisted of—

President :

Colonel W. W. Mitchell, R.A.

Members :

Captain Sir W. Wiseman, Bart., R.N.

Colonel W. J. Smythe, R.A.

Major T. M. Wemyss, Royal Marine
 Artillery.

Captain R. J. Hay, R.A.

Secretary :

Captain A. Noble, R.A.

This Committee was dissolved in January 1859.

June 1852 — The whole subject of Mr. Whitworth's improvements
 in small arms was handed over to the Ordnance
 Select Committee, which had just been re-con-
 stituted, and now consisted of—

Colonel St. George, R.A., President.

June 1852 — Captain Sir W. Wiseman, Bart., R.N., Vice-President.

Lieutenant Colonel Robinson, R.E.

Lieutenant Colonel Greathed, 8th Foot.

Lieutenant Colonel Smythe, R.A.

Lieutenant Colonel Lefroy, R.A., Secretary.

Lieutenant Colonel F. Campbell, R.A., Acting Secretary.

March 1863 — The Ordnance Select Committee were instructed to report upon Mr. Whitworth's large guns, in comparison with Sir W. Armstrong's.

March 1860 — A special Committee was appointed in March 1860, to consider the best gauge, &c. for small arms. It was ordered that it should be considered as a Sub-Committee of the Ordnance Select Committee, and consisted of—

President :

Colonel Steele.

Members :

Colonel Horsford, Rifle Brigade,

Colonel C. Kennedy.

Lieutenant Colonel Hudson.

Captain Hayes, R.N.

This Committee was, however, dissolved in June, 1860, without having carried out any experiments.

June 1860 — The subject of Whitworth and reduced Enfield Small Arms was again referred to the Ordnance

September 1861 — Select Committee, and finally, in September 1861 the question as to the best principle of rifling for Small Arms (which included Mr. Whitworth) was referred to the Ordnance Select Committee, consisting of (at the time the experiments were carried out)—

President :

Brigadier General St. George, C.B., R.A.

Vice-President :

Captain Sir W. Wiseman, Bart., R.N.

Members :

Brevet Colonel Hogge, C.B., R.A.

Brevet Colonel Campbell, R.A.

September 1861. — Lieutenant Colonel B. G. Baynes, Unattached.
Lieutenant Colonel Gallwey, R.E.

Brevet Colonel Lefroy, R.A., Secretary.

Captain Heyman, R.A., Assistant Secretary
and Secretary to Small Arms' Sub-Committee.

With whom the following Officers were associated :

Brevet Major Conolly, Coldstream Guards.

Captain Herrick, 12th Regiment.

July 1860 — Colonel St. George, R.A., Colonel Bingham, R.A.,
and Commander Herbert, R.N., were appointed to
witness some experiments with Whitworth's
breech-loading guns at Southport, with a view to
guiding the Secretary of State in deciding upon
the purchase of some of Mr. Whitworth's guns
for further experiments.

December 1862—A Special Committee on Armstrong and Whitworth
guns was appointed consisting of—

Major General Rumley, from 12th Foot,
President.

Colonel Ormsby, R.A.

Colonel Taylor, R.A.

Captain Preedy, C.B., R.N.

Colonel Simmons, C.B., R.E.

Commander Singer, R.N.

Major Young.

W. Pole, Esq., F.R.S.

John Penn, Esq., F.R.S.

Captain Dyer, R.A., Secretary.*

Alexander T. Tulloh, Major General,
Director of Ordnance.

* To the committee, Mr. Macdonald, one of the business managers of the *Times* newspaper, was added.

(B)

EXPERIMENTS WITH THE MACKAY GUN AND PROJECTILE.

(FROM THE "LIVERPOOL DAILY COURIER," 16th March, 1864.)

It has been known for some time in Liverpool that the Mersey Steel and Ironworks Company—the manufacturers of the celebrated Horsfall gun—were making a gun from designs of Mr. James Mackay, of Aigburth. This weapon was understood to be constructed on a new principle, by which a rotatory motion was imparted to the projectiles, without the aid of rifling in the gun itself; and much interest has therefore attached to the experiments, as one of the most serious drawbacks to rifled ordnance is the diminished velocity with which the shot leaves the muzzle after following the twist of the grooves. Mr. Mackay's gun has recently been completed; and on Monday a series of trials were made, but as these were of a private character, the results only have become known. The new gun was taken to the shore at Crosby, where some experiments were made with the view of testing the general capabilities of the weapon, and of ascertaining the velocity of shot of various weights, with graduated charges of powder. In these experiments the initial velocity was measured by Newman's electrical apparatus, similar to that used at Shoeburyness. With a cylindrical projectile, weighing 100 lbs., and a charge of 20 lbs. of powder, the initial velocity was 1,508 feet per second, although there was a strong wind blowing across the range. The targets were placed at 1,000 and 1,500 yards distant, and in the course of Monday's trials several shots were sent through them. The gun weighs 9 tons, is muzzle-loading, and the bore is 8.12 inches. Of course the experiments have not been concluded, but so far as they have gone they are considered highly satisfactory.

(11th April, 1864.)

A large number of gentlemen were attracted to the Crosby beach, on Saturday, by the experiments which were announced to take place on that day with the Mackay cannon. Owing, however, to the heavy fog which prevailed, the most important experiments were not attempted, and not a single shot was fired at the iron-plate target. The only practice which the weather would permit was some five or six shots fired for sighting purposes at a wooden target 200 yards distance, but even these sufficed to some extent to disclose the great capabilities of the gun, for with a shot of 112 lbs. (the charge being 30 lbs.) the initial velocity obtained was 1640. The experiments on Saturday

being entirely preliminary, we defer entering into particulars until to-day, when, should the weather be suitable, the cannon will be fired against an iron-plated target, the duplicate of the Agincourt's topsides, now building for the Government by Messrs. Laird Brothers.

(12th April, 1864.)

The experiments with the Mackay gun were resumed yesterday on the beach at Crosby. Owing to the anticipation of a large attendance during the day, and of a consequent increase of danger if the experiments were delayed until midday, it was resolved to commence operations at an early hour, and accordingly between eight and nine o'clock the gun was pointed, under the direction of Mr. James Mackay, at the wooden target, which was erected seaward 200 yards distant, and two preliminary shots were fired for sighting purposes. Before describing the effects of the third shot we may here state that the iron target—also 200 yards' range—which is 7 feet square, represents a section of the side of the ship Agincourt, and has been constructed by Messrs. Laird Brothers. It consists of an outer plate of rolled iron five and a half inches thick, backed by a balk of the best teak nine inches thick, behind which again is a three-quarter-inch plate, with angle irons, bolts, &c., representing the skin of the ship. These three casings are firmly rivetted together with bolts of steel, and the whole is supported from behind by barks of elm timber eighteen inches thick. The gun was charged for the third time, in the presence of Mr. James Mackay, the inventor, Mr. Daniel Mackay, Mr. Bouch, of Egremont, and a few other gentlemen, with 30 lbs. of powder and a cast-steel shot $8\frac{1}{8}$ inches diameter, weighing 167 lbs., made by Messrs. Thomas Firth and Son, of the Norfolk Works, Sheffield. The result of the discharge was that the shot struck the target at its strongest point—namely, on the right hand of the bull's eye, a little below and about four inches from the edge—drilled a perfectly circular hole through the outer plate, and made a clear passage through the teak, the three-quarter inch skin, the ribbing, the 18 inch elm supports, and travelled besides 82 yards beyond the target. Lying on the beach, close beside the shot, was found the piece drilled out of the target, and upwards of 50 pieces of bolts and ribbing and skin were found in various directions within a radius of 100 yards. The result of this experiment was considered so triumphantly successful that it was deemed unnecessary to go further or to repeat the shot, and the trial was accordingly suspended. Intelligence that the ponderous target, which, on Saturday, provoked visitors to smile incredulously at Mr. Mackay's confident anticipations of success, had been completely shattered by the first shot, soon reached Liverpool, and hundreds, prompted by curiosity, visited

Crosby beach in the course of the afternoon, and examined the target for themselves. Several professional gentlemen, including Sir John Jones, K.C.B., Captain Fisher, R.N., and Major Inman, Captain White, R.N., and J. Banks Nicklin, C.E., were also present, and on all sides Mr. Mackay was most warmly congratulated on his success. From an examination of the target it appears that it has given way about six inches on the side where the ball struck; this, of course, would considerably reduce the power of the projectile on the inner lining, and the completeness with which the missile accomplished its work of destruction is, therefore, all the more wonderful. When the shot was picked up, it was found that at the point of impact it had been reduced to 11 inches in length, and about $9\frac{3}{4}$ inches in diameter. Otherwise it was perfectly uninjured. The gun which has thus suddenly become famous, and by a single trial conclusively demonstrated its vast superiority to the present ordnance, as well as its formidable pretensions as a rival to the two great pieces which have absorbed the attention of the scientific world for the last two years, has been built for the inventor at the Mersey Steel and Iron Works, and its construction has been personally superintended by Colonel Clay. Its size is that of an ordinary 68 pounder, and it has generally the character of a smooth bore, with the exception that the barrel is grooved for windage. It is the application of this windage which constitutes the chief novelty of the invention. In all other guns the design is to destroy the windage, or as far as possible to weaken its power, and thus lessen the deviation which under the ordinary system of construction must necessarily be its effect upon the shot. Mr. Mackay, however, by a most simple and ingenious contrivance, has so subsidized the gas, that it imparts a rotary motion to the charge, and serves besides as an additional security for safety in the discharge. This is accomplished in the following manner:—The grooves wind spirally round the interior of the barrel, and the shot, which is perfectly smooth, fits closely on the higher levels. The gas thus travels round and round the gun—altogether it is computed six feet further than the shot, and the consequence is that a very rapid rotary motion is imparted to the whole charge. The charge also is so arranged that, through the elasticity of the wadding, the projectile shall be moved slightly before the whole of the powder ignites. This, without detracting from the power of the charge, prevents a sudden concussion to the gun, and considerably lessens the danger of bursting, so much so in fact that Mr. Mackay very confidently expresses an opinion that the gun would not burst with a charge of 100 lbs. of powder. The shot are cylindrical in form, and are balanced from the centre of the length. The rebound of the gun is small in comparison with its immense power, and the

noise of explosion is also comparatively slight. The latter and other characteristics of the discharge were observed with great interest on Saturday. The flash travels about twenty yards, and after its extinction the ball is heard for several seconds spinning in the air. As to the capabilities of Mr. Mackay's invention, the experiment of yesterday speaks best for itself, and it is only necessary to couple with it the fact that on Saturday, with a charge of 20 lbs. of powder, and a shot weighing 112 lbs., the initial velocity obtained was 1,640 feet per second, a velocity which is superior to the registered initial velocity of either the Whitworth or Armstrong guns. The electric machine by which the velocity was taken, was invented by Mr. Newman, of the Electric Telegraph Company, and worked under his superintendence. We believe that the gun and target will remain in their present position on the beach for a few days. No doubt there will be a large number of inspectors of the wonderful weapon, and we understand no obstacles will be offered for the inspection of the gun and perforated target.

(10th May, 1864.)

About seven o'clock yesterday morning the experiments with the Mackay gun were resumed on the Crosby beach, in the presence of a number of gentlemen interested in gunnery. Amongst those on the ground were the Hon. A. Sturton, Captain Fisher, R.N., Major Blundell, Captain Blundell, Lieutenant-Colonel Clay, Mr. A. F. Mackay, Mr. Bouch, Mr. D. Mackay, Adjutant B. Maddison, Mr. C. Mackay, Mr. J. Mackay, Mr. Septimus Booker, and several other gentlemen. On the occasion of the experiments on the 18th of April, we gave a description of this splendid gun, and we would, therefore, just remind our readers that the chief novelty in its construction is its being grooved for windage. Otherwise it has generally the character of the smooth bore. The target representing the side of the Agincourt was the same as used at the last experiment, but it was strengthened by several additional beams placed behind it. It was constructed by Messrs. Laird Brothers, the outer plates of rolled iron being made at the Mersey Steel and Iron Works. This outer skin was backed by nine inches of the best teak, and behind this was a three-quarter inch plate with angle irons, bolts, &c., the target being supported by massive beams of elm timber. On the last occasion the projectile was 167 lbs. in weight, $8\frac{1}{8}$ inches in diameter, and the charge 30 lbs. The bolt struck the target near the outer edge, perforating it in the manner we then described. Doubts were at that time expressed as to whether the success would be so great if the projectile struck the target nearer the centre, but these doubts will be set at rest by the experiments yesterday morning. The gun and target occupied precisely the

same position which they did on the 11th of last month. On this occasion the gun was charged with 30 lbs. of powder, and the steel bolt used was twelve inches in length, and weighed 153 lbs., 14 lbs. less than at the previous trial. The gun was pointed by Mr. James Mackay, and the projectile struck the target at a point which was likely to offer a great resistance, in the centre of the lower plate. The effect was truly wonderful. The bolt made a clear perforation in the outer skin, splintered the teak as if it were rotten wood, grazed the side of one of the huge supporting beams, knocking it over, went into the bank of sand behind, and then travelled 440 yards beyond the target. A large piece of the outer skin, weighing 90 lbs., was buried four feet in the bank of sand behind the target. There were also other pieces of the iron scattered about, and an examination of these proved that no fault could be found with the target, as the iron was of the very best description. The hole made in the plate measured $9\frac{1}{2}$ inches one way and 9 inches another way, the diameter of the projectile, it will be borne in mind, being only $8\frac{1}{16}$ inches. The large steel bolts of the target were also started. The result gave great satisfaction, and Mr. Mackay was congratulated on the success which he had achieved, the gun being manifestly superior to those which have taken up so much of public attention by the trials at Shoeburyness. Since the last experiment with the Mackay gun the attention of Government was called to it in the House of Lords, when Earl de Grey and Ripon remarked on the short range of 200 yards, and said that equal results had been accomplished by the smooth-bore Armstrong, with 150 lbs. spherical shot. It should be borne in mind that the range of 200 yards is the Government range, that the bore of the gun he referred to was $10\frac{1}{2}$ inches in diameter, and its weight 12 tons, and the charge 50 lbs. of powder, whilst the weight of the Mackay gun is only 9 tons, and the charge only 30 lbs. It may be made of a less weight, too, the present gun having only been constructed as an experiment. With a view of testing its accuracy as well as to ascertain the most suitable description of projectile to ensure something like certainty, some experiments were made on Saturday, when two shots were fired from the gun in its present position at a stake placed in the sand, the range being 2,000 yards. There was very little difference between the two shots, and the result showed that both were good projectiles. At the above range, with a charge of 19 lbs. of powder, one bolt weighing 128 lbs. was sent within three feet of the stake, while the other went within four feet of the stake. It will thus be seen that the accuracy with which it can be aimed is equal to its other great powers. We understand that the Messrs. Mackay are having manufactured a 12-pounder on the same principle as that from which such extraordinary

results have been obtained. It is anticipated that the lighter piece will enable a more complete series of experiments to be made as to range, accuracy, &c.

(19th May, 1864.)

Yesterday further experiments were made with the Mackay gun on Crosby beach, in the presence of a large number of influential gentlemen, and the results were highly satisfactory. There were three shots fired—one to show its power against the Agincourt target, another to ascertain the amount of ricochet, and the third to try its range. The weather was beautiful, and besides the large number of gentlemen present, several ladies were attracted to the beach to witness the experiments. Amongst the gentlemen present were Col. Sir John Jones, K.C.B.; Mr. Joseph Christopher Ewart, M.P.; Major-General Sir Edward Cust, Captain Scott, member of the Iron Plate Committee; Major-Blundell, Colonel Younghusband, R.A., F.R.S., member of the Ordnance Select Committee; Mr. James Mackay, inventor of the gun; Captain Bush, R.N., Captain Whyte, R.N.; the Rev. Navison Loraine, Captain Blundell, Captain M'Mullan, Lieutenant C. B. Bean, Captain Murdock, Mr. Jaques Myers, of Crosby-hall; Mr. A. R. M'Pearson, Mr. A. F. Mackay, Rev. A. A. Mann, Mr. Daniel Mackay, Mr. Sill, Mr. Colin J. Mackay, &c. We understand the Earl of Derby, Mr. T. B. Horsfall, M.P., Mr. Bramley-Moore, M.P., and Mr. Charles Turner, M.P., intended to have been present to witness the experiments, but other engagements made their absence unavoidable. The gun and target occupied the same position which they did on the occasion of the previous trials, the range, it will be remembered, being 200 yards. The supports behind the target had been renewed, and the "Agincourt's side" appeared as strong as ever, with the exception of the perforation made in the bottom plate at the previous experiments. The company examined with considerable interest the projectile used at the last trial, as well as the target and the piece "drilled" out. The experiments commenced about eleven o'clock yesterday forenoon, about an hour after the time fixed; but no impatience was manifested by the visitors, to whom the delay afforded a good opportunity of examining the gun and projectiles. The gun was charged with 30 lbs. of powder and a steel bolt 153 lbs. in weight, manufactured by Messrs. Thomas Firth and Son, of Sheffield. Having been "laid" by Mr. James Mackay, all present had to go under cover of a shed behind the sandhills to avoid accident, and the gun was fired in the ordinary way, but with a lengthened cord. The report was not near as loud as might have been expected, considering the size of the gun and the work it accomplishes. Before the reverberation of the

report had died away there was a general scamper along the sands to the target to see what had been done. The young gentleman who got there first went behind the target and threw his hat through the aperture which the projectile had made, about four inches from the bottom of the upper plate, but his hand was badly scorched in doing so. The piece forced out of the outside plate was rather larger than that at the last experiment, which was 90 lbs. After going through the outer plate, and splintering the teak, the bolt smashed the inner skin, making in it an irregular hole 23 inches the widest way and 17 inches the narrowest. One corner of the projectile caught one of the angle irons running up behind the target, and beat it back, moving the whole of the upper plate with its supports about two inches. The striking against the angle iron altered the course of the bolt, which went about 185 yards beyond the target in a north-westerly direction. The piece forced out of the outer plate of the target was found about 125 yards from the target, nearly in a direct line with the target and gun. The projectile was found to be badly cracked all round, and there was a piece three or four ounces in weight chipped off on one side where it had struck the angle iron of the target. It was originally 12 inches in length, but by striking the target was reduced to $10\frac{1}{4}$ inches, the round end being flattened. There seemed to be much difference of opinion as to whether the shot was a good one, the previous projectiles not having suffered to anything like the same extent. The piece which had been chipped off was found in the iron of the target. In fact, the bolt was in such a state that Mr. James Mackay expressed his surprise that it had gone through the target at all, and much more that it had committed such havoc. The hole in the outer plate measured $9\frac{1}{8}$ inches one way, and $9\frac{3}{4}$ inches another way, and the piece which was forced out was about 100 lbs. in weight. The next experiment was to ascertain the ricochet of the bolt. The gun was charged with 2 lbs. of powder and a cast-iron projectile 118 lbs. in weight, the gun being raised to an elevation of $2\frac{1}{2}$ degrees. The shot first touched the ground 325 yards from the gun, when it bounced up and touched the ground 120 yards further. Rising once more, it went a distance of 60 yards, when it again touched the ground and bounded along for 590 yards, the total distance, with only 2 lbs. of powder, being 1,095 yards. The gun was then loaded for the third experiment, to try its range. It was charged with 25 lbs. of powder, and at an elevation of 12 degrees, a cast-iron bolt, about $9\frac{1}{2}$ inches in length, and 130 lbs. in weight, was sent 3,735 yards before it touched the ground. At the point where it dropped there was a large hole, but the bolt doubtless went a considerable distance further. It was not, however, found.

(21st May, 1864.)

The Mackay again distinguished itself on Crosby beach yesterday afternoon. Mr. James Mackay, the inventor, went down about three o'clock with the Messrs. Mackay and a party of ladies, besides one or two friends of the sterner sex, for the purpose of testing the quality of some steel bolts manufactured by himself. The gun was on the fixed platform, at two hundred yards from the Agincourt target. It was charged with 30 lbs. of powder and a steel bolt, similar in shape to those used in former experiments, and weighing 153 lbs., and was discharged point. The shot went clean through the upper plate, striking one of the steel bolts in its passage, and was picked up at 1,475 yards in a direct line from the back of the target, or 1,675 yards from the gun. The 2½-inch steel bolt of the target was picked up at 661 yards from the target; a piece of iron from the target, weighing 20 lbs., was picked up at 600 yards, another piece weighing 40 lbs., at 338 yards, and between that distance and 300 yards were picked up several "splinters," weighing from 40 lbs. to 20 lbs. each. The shot was not altered in shape or reduced in length, but a piece had been chipped from one end where it had come in contact with the steel bolt of the target. Comment on such tremendous power of destruction is needless. As another proof of the strength of the bolt, we may state that the hole in the face of the target, where the first impact takes place, was three-quarters of an inch less in diameter than made by the shots used in previous experiments, while the damage to the back portion of the 5½-inch plate itself, and the combined teak and metal backing, was quite beyond anything before seen.

(23rd May, 1864.)

Another highly-successful experiment was made with this gun on Saturday afternoon, on the beach at Crosby. The bolt used was thirteen inches in length, and weighed 167 lbs., the charge of powder being 30 lbs., the same as on previous trials. The gun was pointed at a mark on the left-hand side of the Agincourt target, that being the only place left that could resist a shot. The bolt hit the centre of the mark, and cut out a circular piece nine inches in diameter, and weighing about 160 lbs., which was picked up about 305 yards beyond the target. The shot was found 384 yards from the target. One piece of angle iron, 5 feet long, and weighing nearly 200 lbs., had been carried to a distance of 160 yards, and another piece, 2 feet in length, was found 110 yards off, the sand in all directions being strewn with bolts and fragments. The target has now been pierced so frequently that it is not fit for more than one shot, but it will be left for

a few days for the inspection of those who take an interest in the important national question with which these experiments are connected. Messrs. Mackay have come to the conclusion that no further object is to be gained by firing steel shot at this plate. The experiments on Saturday were witnessed by Mr. James Mackay, the inventor of the gun, the Messrs. Mackay, and other gentlemen.

(LIVERPOOL DAILY POST, *November 18, 1864.*)

Yesterday this town was honoured by a visit from the eminent Russian engineer, Lieutenant-General Todleben, and his distinguished colleague, Admiral Boutakoff, who are at present on a tour through this kingdom. The visit was necessarily a very brief one, and we regret that the gallant officers were not able to remain longer among us, and to experience that hospitality and hearty welcome which the people of Liverpool would have been delighted to extend to them. The general and the admiral are exceedingly affable and courteous in their manners, and they seemed highly pleased with the cordial reception they have met with during their sojourn in England. General Todleben especially seemed anxious to obtain every information which could be of use to the service of which he is such a conspicuous ornament.

The gallant officers, accompanied by Lieutenant Nicolas de Schilder, the general's aide-de-camp, and their *suite*, arrived at the Lime-street Station from Manchester about twenty minutes to eleven, and were met by N. Mahs (the Russian Consul at this port), Lieutenant-Colonel Clay, Mr. Colin Mackay, and Mr. Simpson, and carriages being in waiting, they were driven thence to the Crosby shore for the purpose of witnessing experiments with the 12-pounder gun invented by Mr. James Mackay. The weather was peculiarly unfavourable, for not only did a drizzling rain descend with most provoking constancy, but there was a strong wind prevailing all the time. The principle on which the gun has been manufactured was lucidly explained to General Todleben and Admiral Boutakoff by Mr. James Mackay, and Mr. Daniel Mackay, and the weapon underwent a very minute inspection. It was explained that the gun was made from a solid piece of steel, and that the shot did not fit in grooves, but that it was balanced from the centre of its length. The gun was elevated at one and three-quarters degrees, and six shots were fired from it, the target, which was nine feet square, being placed at a distance of 1,000 yards. Notwithstanding that it was blowing half a gale of wind, every shot

struck the target, and five out of the six, too, within the "ring," while no less than three shots were "centres." The first three shots were fired while the general was standing even with the gun, though on a spot nearer to the shore; but at his own request the remaining shots were fired while the party were standing sheltered by one of the sandhills halfway between the gun and the target, in order that he might catch the sound of the projectiles as they whizzed through the air. The sound was clearly heard, and as the projectiles sped on with awful velocity, they seemed to do so with what is technically called remarkable "cleanness." After the experiments the general and the admiral proceeded to the target, which they closely inspected, the six rents made therein being clearly discernible. On returning to the gun a projectile was fired off with only a quarter of a pound of powder, and even then it penetrated a distance of more than 2,000 yards. A second projectile was fired, with but an ounce of powder, and that went over 300 yards. Each shot was purposely a ricochet, in order to show the force of the projectile even after it had touched the ground, and it went leaping on and on to the distance we have mentioned. The experiments were pre-eminently successful.

The distinguished visitors were informed that, from experiments recently made, the range of the gun, at 25 degrees elevation, was 7,034 yards, under peculiarly favourable circumstances; the average range being 6,700 yards; at 20 degrees it was 5,600 yards; at 15 degrees 4,700 yards; and at 10 degrees 3,900 yards; while at $1\frac{1}{2}$ degree the shot had dropped 1,070 yards distant. The Armstrong gun at 25 degrees elevation, sent a similar shot 4,700 yards; and the Whitworth gun 5,400 yards, from which it would appear that the Mackay gun has the most extensive range of any similar weapon of war yet invented; and it is believed to possess the additional advantage of accuracy of aim. A 7-inch Mackay gun is now being manufactured at the Mersey Steel and Iron Works, which will fire a 200 lb. or 250 lb. projectile, and this is expected to be ready within three or four weeks, when it will be transported to the Crosby shore, for the purpose of being tested. We should add that the powder used yesterday was obtained from the establishment of Messrs. Harvey and Curtis, of North John-street.

The questions put to Mr. James Mackay and his brother, by General Todleben and Admiral Boutakoff, were so searching and so to the point, that it was quite clear both were most anxious to obtain every possible information with respect to the gun. To those questions the fullest answers were given. The gallant officers examined every part of the weapon with the greatest care, and also the projectiles used, and they particularly noticed the simplicity with which the deadly instrument

was loaded. During the progress of the experiments they testified in an unmistakable manner their satisfaction at the results achieved, and at the conclusion the general said that the gun was a most wonderful invention; that the system on which it had been constructed met with his unqualified admiration; and that in his opinion it possessed many and obvious advantages. He felt deeply obliged to Mr. Mackay for having permitted him to witness the experiments and to make so close an inspection of the gun, and he intimated that the invention would not be lost sight of by him, for as a weapon of warfare it would prove most valuable. Admiral Boutakoff was equally laudatory in his remarks.

Yet, strange to say, notwithstanding that many of the most eminent engineering minds of all countries have testified in the strongest terms to the value of the Mackay gun, and its superiority over every other weapon in use, the authorities at the War-office seem determined not to give it a fair trial. Some time ago Mr. Mackay wrote to Earl de Grey and Ripon, the Secretary of State for War, offering to place his gun at the disposal of his lordship for the purpose of experiments being made with it at Shoeburyness, stating that he would only make the usual charge for the gunpowder consumed, and adding that if the weapon burst before 20,000 rounds of ammunition had been fired from it, he would not call upon the Government for any remuneration whatever, but would defray the cost personally. To this reasonable, nay, handsome offer, the noble lord simply returned an answer to the effect that the gun would not prove advantageous to the military service of this country, and that, therefore, the offer was declined!

Now, seeing that Mr. Mackay has spent no less than 5,000*l.* over his invention, to the value of which the highest testimony has been borne, this is surely somewhat harsh treatment. No effort has been spared by Mr. Mackay with the view of obtaining, as he aptly termed it, "a fair field and no favour," but as all his advances to the "powers that be" have been received with the most decided rebuffs, he feels constrained to turn to other channels for the purpose at once of reimbursing himself, and showing that his invention is what he has all along persistently represented it to be. We believe that he has already received most advantageous offers from the Governments of other countries with respect to his gun, and we are much mistaken if General Todleben and Admiral Boutakoff, on their return to Russia, do not advise their Imperial master to make a trial of the gun too. After the experiments at Crosby, and partaking of luncheon provided by the Messrs. J. and D. Mackay, the party proceeded in three carriages to the Canada pierhead, at which place it was expected that the New Ferry Company's steamer, the Sylph, would be in waiting for

the purpose of conveying the visitors to the Messrs. Laird's works at Birkenhead, and thence to the Mersey Steel and Iron Works. At the request of Colonel Clay, the steamer had been very kindly placed by Mr. Lamont, the secretary to the company, at the disposal of the party, but the time fixed upon for embarking was from half-past eleven to twelve o'clock. Unfortunately, the party did not reach the Canada pier-head until a quarter to two, and owing to the state of the tide, the vessel had to leave at half-past one. As the General and the Admiral had to leave Liverpool by the five o'clock train from Lime-street station, the contemplated visit to Messrs. Laird's works had to be abandoned, and the party drove off direct to the Mersey Steel and Iron Works. Arrived here, they were conducted over that vast and busy establishment by Colonel Clay, who explained to them the various processes in operation. They witnessed the forging of a Mackay gun from a solid piece of steel, and also the rolling of an armour plate, the latter process evidently interesting the visitors very deeply. Colonel Clay also exhibited one of his breech-loading guns, and showed the means by which it was charged, and the contents shot off, observing that from it 18 rounds could be fired in the short space of one minute. The Agincourt target, which was so fearfully riddled some time back by the projectiles from the Mackay gun, was shown the visitors, both of whom rigidly examined the havoc that had been made in it, and the large pieces of solid iron that had been forced out.

It being now nearly four o'clock, General Todleben, Admiral Boutakoff, and Lieut. Nicolas de Schilder cordially shook hands with Colonel Clay and the Messrs. Mackay, and expressed their profound acknowledgments for the courtesy with which they had been received, and the information they had derived from their very hurried visit to Liverpool. It had been intended by M. Mahs to have introduced the gallant officers to several merchants on 'Change, but the want of time prevented this intention being carried into effect.

General Todleben, Admiral Boutakoff, and their *suite* left Lime-street station by the five p.m. train for London, whence they will proceed this day to Woolwich for the purpose of witnessing several artillery experiments. On the following day it is expected they will have the honour of an introduction to our own most gracious Sovereign.

TO THE EDITOR OF "THE DAILY POST."

Sir,—I observed in reading the article in your journal of Friday, regarding the trial of the Mackay 12-pounder windage adaptation gun, that you have alluded to an offer made by me to the Earl de Grey and Ripon, Secretary of State for War, regarding the 12-pounder

gun. As that statement might lead to some misapprehension of the real offer made, I beg most respectfully that you will be so good as to publish the following statement:—"On the 19th of October last I sent a communication to the Secretary of State for War, from the Westminster Palace Hotel, London, offering to make 20,000 12-pound projectiles on my principle at the price allowed to Mr. Whitworth for 12-pounders; and to place the Mackay gun in question in competition with any gun whatever, having exterior arrangements upon any other system, and to continue the firing until the whole 20,000 rounds were discharged, the Secretary of State for War to bear all the expense connected with the trial; but should the gun become destroyed or burst during the firing, no charge would be made by me for the gun." On the 2nd of November his lordship ordered a reply, stating:—"That as the only object to be gained in firing so large a number of projectiles would be to test the endurance of the piece, his lordship must decline to accede to your proposal, it being deemed of no advantage to this department to ascertain the enduring qualities of so small a gun." I am, sir, your most obedient servant, JAMES MACKAY. For the Mackay Ordnance Company. 11, Canada Dock, Liverpool, 19th Nov., 1864.

("LIVERPOOL DAILY MERCURY," *November 18, 1864.*)

Yesterday the celebrated Russian military engineer, Todleben, whose name is indelibly associated with the Crimean war, in the defence of Sebastopol, paid a visit to Liverpool. His visit was merely of a private character, and in connection with a tour of inspection he is now making in this country. The General arrived here yesterday morning, shortly after ten o'clock, from Manchester, at the Lime-street station. He was accompanied by his aide-de-camp, and Admiral Boutakoff, an officer of the Russian navy. The General was met by the Russian Consul at this port, N. Mahs, Esq., and his secretary; also, Mr. J. Mackay, Lieutenant-Colonel Clay, Mr. D. Mackay, and Mr. Simpson. Immediately on arrival the party proceeded in carriages which were in waiting to the shore of Crosby, where some experiments were made with Mr. Mackay's new windage adaptation gun. The gun experimented with was a 12-pounder, the steel of which was made by Messrs. Firth, of Sheffield, and the gun itself by the Mersey Steel and Iron Works Company. A target, eight feet wide, was placed at a distance of 1,000 yards, and a bolt, 12 lbs. 5 oz., with a charge of $1\frac{3}{4}$ lb. of powder, was sent through the target every time the gun was fired at it—six times in all—and three of the shots were within the bull's eye, which is 18 inches in diameter. To show the beautiful spin of the shot, a bolt was fired

with $\frac{1}{4}$ lb. of powder, and again with only 1 oz., and this experiment showed the spin of the shot to be perfect. The last shot went nearly 400 yards spinning like a top. Some other experiments were made showing results as follows:—At a range of 10 degrees, 4,000 yards; 15 degrees, 4,700 yards; 20 degrees, 5,400 yards; 25 degrees, 7,084 yards. The General, as well as Admiral Boutakoff, expressed themselves much pleased with the weapon and the results attained. The party then proceeded to the Canada Dock, where a short time was occupied in inspecting the immense gates. It had been arranged that the party should enjoy a sail on the river, and one of the south end new ferry boats, through the instrumentality of Mr. R. Lamont, was brought to the pier for that purpose about twelve o'clock, when it was expected her services would be required for a cruise on the river, and also for crossing to Woodside, where the General might have had an opportunity of inspecting Messrs. Laird's works. Owing to the progress of the party being somewhat delayed, and also to some misunderstanding, the boat, after waiting about an hour and a half, left the pier. The General then drove along the whole length of the docks, the length of time occupied in which would give him a good idea of their magnitude, to the works of the Mersey Steel and Iron Company, where he inspected with great interest the numerous iron-founding processes. The Agincourt target, which had been shattered by the large Mackay gun, was then inspected by the General. Afterwards the party drove to the Lime-street station, and left Liverpool by the five o'clock train for London. It is understood that to-day the General visits Woolwich, to attend some artillery practice by military officers, and on the following day he will be introduced to her Majesty the Queen. The General is an unassuming gentlemanly man, about the middle age, and travels in his ordinary dress. Before leaving he expressed his thanks to the Russian Consul and the other gentlemen who had accompanied him on his trip throughout the day.

(“LIVERPOOL DAILY COURIER,” *November 18, 1864.*)

Shortly after ten o'clock yesterday morning, General Todleben, the celebrated Russian engineer, arrived in this town from Manchester. He was accompanied by Admiral Boutakoff, another distinguished Russian officer, and his aide-de-camp. At the station he was met by Mr. Nicholas Mahs, the Russian consul, Colonel Clay, and Mr. Mackay, jun. The programme for the day was that General Todleben should first inspect the Mackay gun at Crosby, and then proceed by steamer from the Canada Dock to the Mersey Steel and Iron Works. Accordingly the party at once proceeded to Crosby Sands, to witness some experiments with Mr. Mackay's 12 lb. windage adaptation gun.

At Crosby, they were joined by Mr. James Mackay, the inventor, and Mr. D. Mackay. The 12-pounder, as our readers are probably already aware, is of steel, made by Messrs. Firth, of Sheffield, and has been turned and bored by the Mersey Steel and Iron Works Company. The target, which is eight feet wide, was reared at a distance of 1,000 yards. The bolts weighed 12 lbs. 5 ozs. each, and the charge of powder was $1\frac{3}{4}$ lbs. On the whole six shots were fired at the target, all of which hit it, and three of which went right through the centre, making clean cut holes so regular as to excite the surprise of all present. To enable the General to hear the spinning sound of the shot—a peculiarity of this gun which has been often noticed before—four shots were fired out to sea at an elevation of ten degrees. One shot was then fired with a quarter of a pound of powder for ricochet, and another with one ounce of powder, which sent the charge spinning like a top for 400 yards. The following are the ranges of this gun:—At an elevation of 10 degrees, 4,000 yards; at an elevation of 15 degrees, 4,700 yards; at 20 degrees, 5,600; and at 25 degrees, the enormous range of 7,084 yards. General Todleben expressed himself delighted with the weapon, and with the experiments he had witnessed. We may here state that the gun with which these experiments were made has been offered to the Government by Mr. Mackay on very advantageous terms, but the Secretary of State for War refused the offer on the ground that it would be of no use to test so small a piece of ordnance. The Messrs. Mackay, therefore, disgusted with the procrastination of the British Government, have resolved to manufacture and supply the guns on their own account. General Todleben was so interested in the experiments yesterday that he spent more time at Crosby than was anticipated, and the consequence was, that on the arrival of the party at the Canada Dock the steamer in which they had intended to survey the river was gone. The General was then driven along the line of docks to the Mersey Steel and Iron Works. He was conducted over the forge by Colonel Clay, and inspected the various processes with a great appearance of interest. An armour plate was rolled in his presence, and he was also shown the Agincourt target, which was pierced by the eight-inch Mackay gun, and the new seven-inch gun which is now in course of construction, and the distinguished engineer was both delighted and astonished with all he saw. From the Mersey Forge the party drove to Lime-street station, whence General Todleben departed for London by the five o'clock train. To-day (Friday) he will visit the Royal Arsenal at Woolwich, and on Saturday he will be presented to her Majesty the Queen, at Windsor.

(“THE ALBION,” *November 21, 1864.*)

On Thursday General Todleben, the eminent Russian engineer officer, paid a short visit to Liverpool, accompanied by Admiral Boutakoff and his aide-de-camp. He arrived in Liverpool, from Manchester, shortly after ten o'clock, and was met by Mr. Nicholas Mahs, the Russian Consul, and by him introduced to Colonel Clay, of the Mersey Steel and Iron Works, and Mr. Colin Mackay. By these gentlemen he was escorted to the Crosby beach, and there he witnessed some interesting experiments with Mr. James Mackay's 12-pounder windage adaptation gun. A target, eight feet wide and nineteen feet high, had been placed at a distance of 1,000 yards, and every time the gun was fired at it (six in all) the target was hit, and three of the shots passed within the centre ring. The General and party then walked some distance in the direction of the target, and the gun was fired at an elevation of ten degrees. The peculiar steady whirr of the bolt, as it sped on its journey of 4,000 yards, was plainly heard, and evidenced its perfect spin. Still more to prove to the General the perfect and steady spin of the shot, the gun was fired first with a charge of a quarter of a pound of powder (the usual charge being $1\frac{3}{4}$ lbs.), and the spin of the shot, as it ricocheted for nearly 2,000 yards, was clearly discernible. Again the gun was fired with only one ounce of powder, and the bolt played “ducks and drakes” over the sand for a distance of 400 yards, and ended by spinning round like a top. The General, who speaks English very imperfectly, gave Mr. Mackay to understand that the performances of the gun had pleased and interested him very much; that the principle of the gun was evidently the correct one, and that it must not be lost sight of. We may here mention that one of the greatest advantages of Mr. Mackay's principle is that the constant firing does not injure the gun. The one experimented with has now been fired over five hundred times, and the edges of the grooves are still as clearly cut as on the day it was turned out from the works. Mr. Mackay has such confidence in the durability of his gun, that he has offered to supply a gun to Government, and if it bursts before 20,000 rounds have been fired, to bear all expenses himself. Our Government, notwithstanding his most conclusive trials, has not given him the slightest satisfaction; and he, therefore, now feels at liberty to let others take the gun. The experiments over, the party drove to the Canada Dock, where it had been arranged a steamer should be in waiting to convey them to Messrs. Laird's works at Birkenhead. On their arrival, however, they were considerably after the time fixed, and through some misunderstanding the boat had left. They, therefore, drove along the line

of docks, thus giving the General an excellent idea of the extent of our Dock Estate, to the Mersey Steel and Iron Works, where the various departments were inspected. The boring of the guns, the forging, by means of the massive steam hammers, and other processes, were examined with great interest. In the yard was the wreck of the Agincourt target, which had been pierced in five places by the steel shot from Mr. Mackay's eight-inch gun. This target was closely examined by the General, and his surprise at the effects of the gun was manifest. He then drove to Lime-street station, and at five o'clock left for London.

THE END.

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